MODERN MECHANICS AND INVENTIONS

JAN
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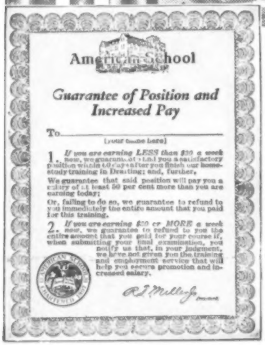
A Plane Smaller Than a Bird!
See Page 62

HOW TO MAKE YOUR OWN SPORT PLANE

Training
PREPARING you to fill a fine Drafting job at a substantial raise in pay . . . .
Employment
FINDING you the better paid position and PLACING you in it, or money refunded . . .


American School

Guarantee of Position and Increased Pay

To_____
(your name here)

1. *If you are earning LESS than $30 a week now*, we guarantee to find you a satisfactory position within 60 days after you finish our home-study training in Drafting; and, further,

We guarantee that said position will pay you a salary of at least 50 per cent more than you are earning today;

Or, failing to do so, we guarantee to refund to you immediately the entire amount that you paid for this training.

2. *If you are earning $30 or MORE a week now*, we guarantee to refund to you the entire amount that you paid for your course if, when submitting your final examination, you notify us that, in your judgment, we have not given you the training and employment service that will help you secure promotion and increased salary.

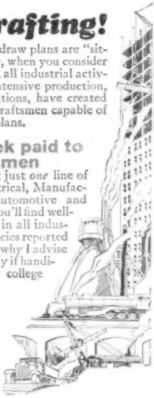
R. J. Miller Jr. Director

Come into Drafting!

Men who can read blue-prints and draw plans are "sitting-pretty" these days. No wonder, when you consider that every machine, every building, all industrial activities *start* on the Drafting table! Intensive production, record-breaking construction operations, have created a tremendous demand for expert Draftsmen capable of designing and calculating original plans.

$50 to $125 a week paid to Expert Draftsmen

Get this point—that Drafting isn't just *one* line of work—it reaches out into the Electrical, Manufacturing, Building Construction, Automotive and Structural industries. That is why you'll find well-paid Drafting positions advertised in all industrial centers of the U. S. 70,000 vacancies reported in the past 12 months. And that is why I advise men to go into Drafting, particularly if handicapped by lack of high-school or college education.



Coupon Brings Job Offer!

You will never have a more serious personal problem than deciding your future life-work. So we merely urge you to LOOK INTO DRAFTING. See how you like it, see how easily it can be learned at home in spare time by our practice method—get the facts about the jobs open for Draftsmen in many industries, the opportunities for advancement. Just mail the coupon and see how we have helped other men just like you to successful careers in Drafting—how we undertake to train you and place you and raise your pay—or no cost.

A Drafting Job Guaranteed

Paying 50% more than you earn today —or not a penny of cost!

Now, at a cost you can afford, on terms of only $6 per month, you can actually BUY a fine Drafting position and a substantial increase in pay. A two-million-dollar institution guarantees both—the training, then the employment. *Under money-back penalty.*

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Chartered 32 years as an EDUCATIONAL institution like the best resident schools and colleges. We offer complete, thorough, up-to-date instruction, built by 200 leading Educators, Engineers and Executives. A unique instruction, built to meet the specifications of well-paid jobs as laid down by employers themselves, yet simplified for ready understanding by men with only common schooling.

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Dept. D-1310, Chicago

O. C. MILLER, *Director Extension Work,*
THE AMERICAN SCHOOL,
Dept. D-1310, Drexel Ave. and 58th St., Chicago, Ill.
Please send without cost or obligation:
1. Facts about the opportunities in Drafting.
2. Your Guarantee to train and place me under money-back penalty.

Name_____

Address_____

Age_____ Occupation_____

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Just fill out the blank below and enclose $2.50. A *Greeting Card* announcing your gift will be sent to the person designated—and throughout 1929 Modern Mechanics will be a monthly reminder of your thoughtfulness.

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we help to make you a master electrician, teaching you far more than the average ordinary electrician ever knows and fitting you to hold big jobs after graduation.

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No dull books, no baffling charts, no classes, you get Individual training . . . all real actual work . . . building real batteries . . . winding real armatures, operating real motors, dynamos and generators, wiring houses, etc., etc. That's a glimpse of how

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COYNE ELECTRICAL SCHOOL, Dept. 19-61
500 S. Paulina Street, Chicago, Illinois

Dear Mr. Lewis:

Without obligation send me your big free catalog and all details of Free Employment Service, Radio and Automotive Courses without extra cost, and how I can "earn while learning." I understand I will not be bothered by any salesman.

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Address .....

City ..... State .....

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January, 1929
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MODERN MECHANICS AND INVENTIONS

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This magazine is not connected or associated with any other magazine of a scientific or mechanical nature.

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EDITED *by* EXPERTS

Listed below are the members of the Modern Mechanics board of editors, all qualified by national repute to serve as authorities. They will gladly answer questions from our readers concerning their departments. Address them in care of this magazine, Robbinsdale, Minn.

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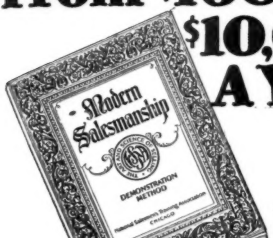
From $160 a Month to $10,000 A Year!



This Astonishing Book Showed Him How

How One Man Uncovered Hidden Possibilities He Never Suspected Within Himself and Raised His Yearly Income $8,080! An Illuminating Message of Vital Interest to Every Man Who Ever Aspires to Earn $10,000—$20,000—or More a Year! SEE FOR YOURSELF This Remarkable Volume That Has Led So Many Men Into the Five-Figure Salary Class!

Where Shall We Send Your Copy....FREE?

TRUTH *is* stranger than fiction! And the true story that happened to R. B. Hansen proves it! His experience *is* not only intensely INTERESTING—but it will prove a revelation and positive inspiration to every ambitious man who reads this page.

Not long ago Hansen was working as a foreman in a rubber plant. His salary was $160 a month. That meant skimping and petty economies that are bound to irk ANY ambitious man. Naturally he was keenly dissatisfied—but like so many other men caught in blind-alley jobs, he didn't know how to get out!

And then one day something happened! A certain book fell into his hands. Between its covers he discovered a certain force that eventually led him to rewards beyond his fondest expectations. Inspired to action and with his feet firmly guided to the first rungs of the ladder to Success, Hansen went into business for himself. And within a short time he had boosted his earnings to $10,000 a year!

Salary Increases—200% to 900%!

A lucky accident? Not a bit of it! Hansen *is* not alone in his achievement of success after reading this remarkable book. OTHER men who have increased their salaries amazingly after reading these vital facts are numbered in the thousands! For example, C. W. Birmingham of Ohio read it and his salary raised from $15 a week to $7,500 a year. Wm. Shore of California made $3,000 his first 7 months. And O. D. Oliver of Oklahoma, who used to earn $200 a month, now makes as much as $1,000 in a single week!

How did they do it? What did the book show them? Just this—Every one of these men realized that Salesmanship offers BIGGER rewards and delivers them QUICKER than any other line of work under the sun. This vital book, "Modern Salesmanship," introduced them to hundreds of surprising and little-known facts about the highest paid of all professions,—SALESMANSHIP. It blasted dozens of old theories, explained the science of selling in simple terms and told them exactly how the great sales records of nationally-known star salesmen have been achieved. And not only that, it outlined a simple plan that will enable almost any man to master scientific salesmanship without spending years on the road—without losing a day or dollar from his present position.

Free to Every Man

If we were asking two or three dollars a copy for "Modern Salesmanship" you might hesitate. But it is now FREE. We cannot urge you too strongly to take advantage of this opportunity to see for yourself what salesmanship has done for others—and what the National Salesmen's Training Association stands ready and willing to do for you. Find out exactly what the underlying principles of salesmanship are—and how you can put them to work for you. No matter what your opinion is now, "Modern Salesmanship" will give you a new insight into this fascinating and highly-paid profession.

Mail the coupon now!

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Dept. A-701 N. S. T. A. Bldg. Chicago, Ill

National Salesmen's Training Ass'n.,
Dept. A-701, N. S. T. A. Bldg.,
Chicago, Illinois.

Without cost or obligation you may send me your book, "Modern Salesmanship," with details of your system of training and FREE employment service.

Name .....

Address .....

City..... State.....

Age..... Occupation.....

Thank You for Mentioning Modern Mechanics When Writing to Advertisers

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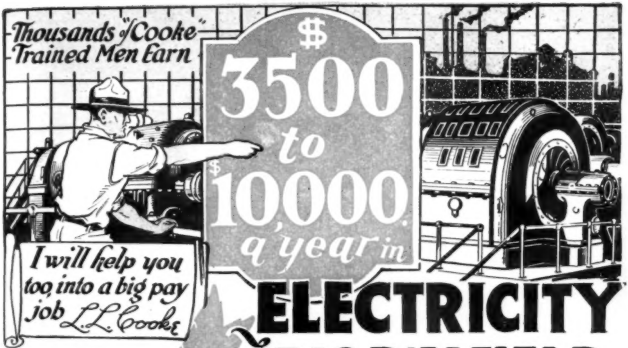
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$3500 to $10,000 a year in
I will help you too, into a big pay job L. L. Cooke

ELECTRICITY the BIG PAY FIELD

LOOK WHAT I'VE DONE FOR THESE TWO MEN

$75 A WEEK!

"Dear Mr. Cooke: I was working in a store for $18 a week when I started your Course. Then I began doing Electrical Work in my spare time. Now I average as much as $75 a week."

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194 Robin St.,
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"Dear Chief: If it hadn't been for your wonderful Course I wouldn't now be making as high as $65 a day. It makes me proud to have your Diploma. And believe me I am a booster for your course."

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Even ordinary electricians — the common "screw driver" kind are making big money. But the Trained Man — the man who can plan and boss and supervise the work of others — is needed everywhere today at $300 to $900 a month! And thousands of "Cooke" Trained Men are getting this big money right along! Don't YOU be satisfied with anything less!

Learn At Home

You don't need a College education nor a High School diploma to learn Electricity from me. And you don't have to quit your job nor even lose a single hour's pay! With my famous "Work Sheet" and "Job Ticket" Method I train you at home. And I train you right! You get not only theory but practice! I give you Six Big Working Outfits without extra charge so you learn by doing! That means you learn Electricity right — learn it so you can quickly become a Big-Pay Man in this Big-Pay field!

L. L. COOKE --the man who has trained and helped thousands of men.

Earn While You Learn

Not only do I give you an Electrical Training that is thorough and complete—the training that Electrical Experts recommend and Electrical Companies select for their employees—but I show you, right from the start, how to make spare time money doing little electrical jobs that more than pay for the entire Course! Later comes the Big Job and the Big Pay—an income large enough to make you independent the rest of your life!

Get Started—Mail Coupon!

You want big money—you want to get into work where men are in constant demand. Then act! Get my Big Pay-Raising Book. It's free. Shows why "The Cooke Trained Man is The Big Pay Man" everywhere and always! Shows how easily YOU too can become a "Cooke" Trained Man with a real honest-to-goodness income. Get started. Mail coupon at once!

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Chief Instruction Engineer
L. L. COOKE SCHOOL OF ELECTRICITY
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Dept. 681, 2150 Lawrence Ave., Chicago, Ill.

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Name _____

Address _____

City _____

Residents of Canada may send this coupon to R. A. Farrow, Special Representative, 7 Medbury Lane, East, Windsor, Ontario, Canada.

The "Cooke" Trained Man is the "Big Pay" Man

"They Snickered When I Got Up To Speak"

—But from the First Word, I Held Them Spellbound

THE banquet hall was crowded. Suddenly I heard the chairmans' voice say—"We will now have a few words from Mr. Byron Munn." It came like a flash of lightning! He was unexpectedly calling on *me* for a speech!

As I started to get up, I heard a titter run around the table.

"Watch him make a fool of himself," I overheard someone whisper. "He's so bashful he's afraid of his own voice."

I knew they were expecting me to make myself ridiculous, but I only grinned inside.

I stood squarely on my two feet and started in!

"But When I Commenced to Speak"—

Almost from the first word, the smiles and derision faded from their faces. They were incredulous—amazed! Instantly the atmosphere became so tense that you could have heard a pin drop! No snickers nor sneers now. My voice, clear as a bell—strong, forceful, unfaltering—rang out through the banquet hall as I hammered home each point of my message with telling strokes! I let myself go—soaring to a smashing finale that almost brought them to their feet!

When I finished, there was an instant of dead silence! And then it came—a deafening wave of applause rolling up from one hundred pairs of hands—spontaneous, excited, thrilling!

What 20 Minutes a Day Will Show You

How to talk before your club or lodge.
How to address board meetings.
How to propose and respond to toasts.
How to make a political speech.
How to tell entertaining stories.
How to make after-dinner speeches.
How to converse interestingly.
How to write letters.
How to sell more goods.
How to train your memory.
How to enlarge your vocabulary.
How to overcome stage fright.
How to develop self-confidence.
How to acquire a winning personality.
How to be the master of any situation.

Was Once a "Human Clam"

After it was all over, Jack Hartray fell into step beside me as I left the hall. "Gee, that was a great speech!" he said enthusiastically. "You certainly raised yourself about 100% in the eyes of every person in that place tonight. . . . And yet they used to call you 'a human clam'—and the quietest man in the office!"

It was true too. All my life I *had* been handicapped with a shy, timid and retiring nature. With only a limited education I never could express my ideas in a coherent forceful way. As a result I saw dozens of men with less ability pass me by simply because they were good talkers and knew how to create the right impression. It was maddening.

A Lucky Accident

At last I accidentally ran across a little book entitled *How to Work Wonders With Words*. Between its covers I discovered certain facts and secrets I had never dreamed of. Difficulties were swept away as I found a simple way to overcome timidity, stage-fright, and self-consciousness—and how to win advancement, popularity and success.

Today I hold the port of position that I had always envied. My salary has been increased! I am not only in constant demand as a speaker in public but I am asked to more social affairs than I have time to attend. To sum it all up, I am meeting worth-while people, earning more than I ever dared expect and enjoying life to the fullest possible degree! And furthermore, the *sheer power of speech* has been the big secret of my success!

The experience of Byron Munn is typical. Not only men who have made millions, but thousands of others have found success after learning the secrets of powerful, effective speech. Being able to say the right *thing* in the right *way* at the right *time* has perhaps been responsible for more brilliant success than any other one thing under the sun!

Get This Amazing Book FREE!

Right now, we offer to send you absolutely free, a copy of *How to Work Wonders With Words*. This remarkable little book will show you how to develop the priceless "hidden knack" of effective speech that has brought success, social position, power and wealth to so many. It will open your eyes to a new realization of what life holds in store. See for yourself! There is no obligation. You can obtain your copy free by just sending the coupon.

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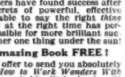


North American Institute, Dept. 2051
3601 Michigan Ave., Chicago, Ill.

Please send me FREE, without obligation, my copy of your inspiring booklet *How to Work Wonders With Words* and full information regarding your Course in Effective Speaking.

Name .....
Address .....
City ..... State .....

When they cut the pay roll

—will you be hunting for another job?

It usually comes like a bolt from the blue—

You are called into the manager's office—he looks troubled, worried—reluctantly he explains that business isn't holding up, he has more men than he needs. *And what can he do!*

Suddenly it dawns on you that you're being politely told you're *through!*

You've cut off—and you've got to start selling your ability in competition with thousands of other men in the same fix!

Make Sure of Your Future Now through Practical Home-Study Training

WHAT assurance is yours that when the "axe" falls, it will not hit you?

What assurance is yours that if you are suddenly thrown out of employment—through no fault of yours—you can always get back in, at an attractive salary?

Thousands of men—in every large city in America—are face to face with that problem now.

Upon some the "axe" has already fallen. They are trying as best they can to sell their services, yet they find themselves faced with the fact that the market is flooded with men who can offer just as much as they.

Men Who Are Never Fired —Steadily Promoted

For thousands of others, however, the "axe" has not the slightest terror. Regardless of how drastically their employers chop the pay roll, they know they will steadily advance—either with the companies they now are serving or with others which need precisely what they have to offer.

For how can it be otherwise?

Suppose, for example, you could point to some twenty-seven suggestions you had already made to your company, representing savings from $20 to $75 daily—as did J. R. Hollingsworth, in charge of a shift of men at one of the big factories in Akron . . .

Or suppose, as a trained salesman, you could increase the sales in your territory 50 per cent—as did I. A. Gould, district manager for Michigan for the Smith Agricultural Chemical Company, Columbus, Ohio.

Or suppose that the balance sheet of your employer showed that—through your knowledge, as accountant, of the various factors that determine the success of a business enterprise—you had turned a loss into a profit—as did E. W. Neir, manager of the Hotel Rowe, Grand Rapids.

Or suppose you could demonstrate specialized ability in Personnel Management, say, or Business Correspondence, or any one of a dozen other attractive fields of business where good men are always in demand and where proved ability quickly finds its reward in increased responsibility and increased pay.

How could any business man who was blessed with sense be persuaded to part with your services *—when very clearly those services were showing him a handsome profit!*

Are you one of those men who wake up to their needs only when unemployment stares them in the face?

Can you afford to side-step so important a matter any longer—when at home, without losing an hour from work or a dollar of pay, you can *make your position sure, can steadily equip yourself for greater earning power?*

The Secret of Success —Preparedness!

On the coupon indicate the training that most clearly meets your need—fill in your name, address and present position, and place the coupon in the mail.

It will bring you—free—an attractive book clearly outlining the opportunities in the business field of your choice, together with a free copy of "Ten Years' Promotion in One," the book that has started thousands of men on the shorter path to a bigger income.

Do you mean what you say when you say that you want to get ahead?

Prove it by what you do with this coupon—NOW!

— — — — *Find Yourself Through LaSalle!* — — — —

LaSalle Extension University

The World's Largest Business Training Institution

Dept. 1493-R **Chicago**

I would welcome an outline of the LaSalle plan, together with a copy of "Ten Years' Promotion in One," all without obligation.

- ☐ Business Management
- ☐ Modern Salesmanship
- ☐ Higher Accountancy
- ☐ Traffic Management
- ☐ Railway Station Management
- ☐ Banking and Finance
- ☐ Modern Business Correspondence
- ☐ Business English
- ☐ Effective Speaking
- ☐ Telegraphy
- ☐ Law—Degree of LL.B.
- ☐ Commercial Law
- ☐ Credit and Collection Correspondence
- ☐ Industrial Management
- ☐ Modern Foremanship
- ☐ Personnel Management
- ☐ Expert Bookkeeping
- ☐ Commercial Spanish
- ☐ C. P. A. Coaching
- ☐ Stenotypy—Stenography

Name.....

Present Position.....

Address.....

Be a B.W. Cooke-Trained AUTO EXPERT

I Train You At HOME

EARN up to $5000 A YEAR

Get this Complete Now-for my FREE AUTO BOOK

Start to Make Money Quick Like Morriston

M. J. Morriston, Parkersburg, W. Va., started right never had a day's training. Now he is making big money. Read what he says when less than half way through his "JOB-WAY" course. "What I have already learned is worth over $500 to me. I have gone into business and I'm making over $50 a week on auto work. Before I took up your course I was a carpenter. And what Mr. Morriston and hundreds of others have done I will help you to do!

M. J. MORRISTON, Parkersburg, W. Va.

The World's biggest, most fascinating business needs you!

You wouldn't stay away at small wages another minute—mail coupon and I'll tell you how I train you at home in your spare time for positions paying up to $250 a week. Unlimited opportunities for trained Electrical and Mechanical Auto Experts. Let me show you how my "JOB-WAY" training has prepared hundreds of men just like yourself for a quick, brilliant success in the Auto business.

Earn Up to $150 a Week!

Don't sell your time for low pay! You don't need to when you have my "JOB-WAY" training. As Directing Engineer of this Institution I know what training you need to succeed, AND I GIVE YOU THAT TRAINING right in your own home. MASTER every branch of Auto, Truck and Tractor work. I train you with JOBS—not books. I bring the original "JOB-WAY" training TO YOUR HOME!

Read My Money-Back Agreement!

Ten agreements in my big free Auto book. No. 1 is "I will refund every cent of your money if after receiving my training you are not absolutely satisfied." This and nine other wonderful agreements make my "JOB-WAY" course the training for you! Be sure to get my book and read all ten agreements.

Experience, Education Not Needed!

I don't care how little schooling you have, I will train you to become an Auto Mechanic or refund your money! Boys and men of all ages have become Garage owners and managers, Superintendents, Foremen, Auto Experts, BIG PAY executives, after completing Cooke "JOB-WAY" training. I prove to you that I will prepare you to take advantage of the many wonderful opportunities of the great auto business!

No Other "JOB-WAY" Training!

My training includes ALL Electrical Work—Ignition, Starting, Lighting—ALL Mechanical end, Welding, Brazing, Vulcanizing—also Business Course—also Monthly Magazine, also 3 Testing and Repair Outfits. Nowhere else. I know of, can you get ALL this!

Six Billion dollars spent each year to repair 18 Million Autos, Trucks, Tractors—it's the world's biggest business. Amazing money opportunities everywhere for trained men. My Employment Service helps you to big jobs, and I help you to get into business for yourself.

Get My Big Book Quick!

I will send it to you without one penny of cost. Read all the facts, find out about the demand for trained Auto Experts. Let me tell you how easily and quickly you, too, may become an Auto Expert. Splendid offer right now to ambitious men. Coupon brings complete information. Mail it today!

3 Testing repair OUTFITS INCLUDED

AVIATION Training FREE of extra cost

Coupon brings full details of complete Aviation Training. I am offering FREE of extra charge. Send it now.

MAIL THIS COUPON NOW!

Free Auto Book

B. W. COOKE, Directing Engineer,
Chicago Motor Training Corp.
1916 Sunnyside Ave., Dept. 1321 Chicago

Send me FREE your Big Auto Book "Auto Facts" and proof that you will train me in spare time at home. Also details of AVIATION Course Offer. Also reserve 3 Testing and Repair Outfits without obligating me.

Name .....

Addr... .....

Age ..... Occupation .....

City ..... State .....

Address Me Personally **B. W. COOKE** DIRECTING ENGINEER

CHICAGO MOTOR TRAINING CORPORATION
1916 Sunnyside Ave., Dept. 1321 Chicago, Ill.

FREE to Bald Men

Clayt Vreeland—as I am today. See my head of hair.

Bald Headed Clayt Vreeland as he used to be. Ugh!

One Full Ampoule of amazing hair fluid which I discovered myself and which grew hair on my head.

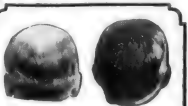
This Ampoule is absolutely free. Don't send any money. There is no C.O.D. No charge whatsoever. All I want is an opportunity to show you how easily I grew hair on my own and hundreds of other men's heads. Merely mail the coupon below for Free Ampoule.

Here Is How I Used to Look

I was just as bald as this picture. It is a true photograph without any tampering or retouching. It is exactly as I used to look. Then look at the full head of hair I have in the picture on the left! . . . As I have stated so often, I don't know whether I am the first man who discovered this great secret, but I do know I have it, that I grew my own hair and that I am growing hair on the heads of other men.

Bald Men Grow Hair *Quick!*

What I accomplished on my own head and on other heads I can do for you, provided you are under 45 years of age and loss of hair was not caused by burns or scars. Anyhow, I must succeed or you pay nothing. No apparatus. My home treatment is simple, quick, inexpensive.



Here is Brennan
Brennan while he was bald. And Brennan after Vreeland grew his hair. Write and I will tell you Brennan's story and give you his address.

Here is Wiseman
Wiseman was bald like this. But Wiseman grew this head of hair with my wonderful hair growing fluid. All about Wiseman and how he did it. If you write. You will get his address, too.

Mail This FREE Coupon!

Mail the coupon today—Right Now—I will send you, immediately, one full Ampoule of my marvelous fluid which I discovered, of which I hold the secret and which grew my own hair on my own bald head.

Besides the Free Ampoule of fluid, I will send photographs, names, addresses of men and women who successfully used my Wonder Fluid for Dandruff, Falling Hair and Baldness.

VREELAND
23-25 Euclid-Windsor Building, Cleveland, Ohio

FREE COUPON

VREELAND 23-25 Euclid-Windsor Bldg. CLEVELAND, OHIO

Please send me, entirely free, one full Ampoule of the same Wonderful Hair Fluid which grew your hair.

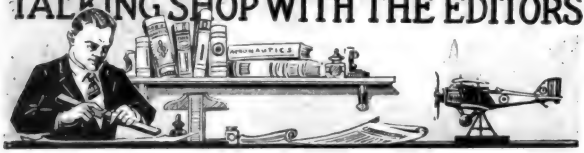
My Name.....

My Address.....

State.....

Thank You for Mentioning Modern Mechanics When Writing to Advertisers

TALKING SHOP WITH THE EDITORS



THE ROUSING welcome given to MODERN MECHANICS is reflected by the flood of letters from enthusiastic readers. Letters from Singapore and London, from Florida and Alaska, from New York and Los Angeles, continue to pour in on the Editors in an undiminished stream, and from these letters we learn what features appeal most to men who have found an informative companion in MODERN MECHANICS.

A letter from Justin Thornquist, Livermore, Cal., reflects the enthusiasm felt for T. A. Hodgdon's informative article on the "souping up" of motorcycle engines for light airplane use which appeared in December. Mr. Thornquist sat himself down to the old type mill and banged out the following:

> I have just read the article in your magazine on how to utilize a motorcycle engine for light airplanes, and believe me, boys, I have been waiting for something like that for so long I nearly died of joy! I feel that a little better than .001 of an inch clearance ought to be allowed for lap on piston rings which are to be used with aluminum pistons on little coffee grinders like those air cooled motors, but then, I am no judge. What do you think?
>
> Livermore, Cal. Justin Thornquist.

The light airplane editor is inclined to think that a bit better than .001 of an inch clearance could be allowed, and suggests that Mr. Hodgdon meant .001 inch of lap clearance *per inch of engine bore.* However, Mr. Hodgdon, being connected with one of the largest motorcycle companies in the country, "knows his stuff" cold, and his prescription is undoubtedly best.

There is a storm of interest sweeping the country as a result of the announcement concerning the publishing of the Heath Parasol Sportplane plans, and many of you will probably file the series in your scrap book, because it is the only "How to Build" of its kind ever published and will be the forerunner of several others we now have in our files, all designed to acquaint you "kaydets" with all the little intimate details of airplane construction. Among them is the "Baby Bullet."

Stewart Rouse, MODERN MECHANICS flying cover artist, who painted the cover on this month's MODERN MECHANICS, is a close personal friend of Ed Heath, the Chicago light plane fan, airplane designer and builder. Heath is really the daddy of the American light plane movement, and as a light plane designer and racer he has no peer in this country. Rouse spent sleepless nights and happy days right in the Parasol hangar, taking off measurements for the little ship, and wrote us when the job of writing was done that he had completed a labor of love.

Rouse himself is a crack pilot. Aside from his talent as an artist, he can fly anything. Not only can that boy draw, but with his flying experience as a background, it may be said of him that there is hardly another lad in America who knows what a good airplane looks like and who can at the same time lay it onto canvas or illustration board for the Hangar Gang to see it the way he can. This again is in line with the MODERN MECHANICS policy, "edited by experts." The familiar SR brand is shown here with a self-drawn picture of the sky high illustrator.

(Continued on Page 16)

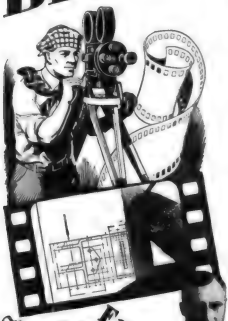
The "MOVIE WAY" Replaces Old-Fashioned Methods

Get Into This

BIG PAY WORK

with my amazing, new, simple

MOVIE-METHOD



At last—a quick, complete, fascinating way to learn Drafting, and learn it **right!** Experts acknowledge my new, simple, easy "Movie Method," without the use of dark rooms or projectors, to be the first new idea in teaching Drafting in 30 years. It's the most easily-grasped, sound and sensible plan ever devised for Home Study instruction—so clear, so interesting, so practical that almost before you know it, you're through—have finished—and are ready to go to work on a Big Pay Job.

Learn to Earn—$60 to $100 a Week

That's what the expert draftsman gets. And he's never out of work the year 'round—for he's the King-Pin of Industry—the man they've got to have. Not a wheel can turn, not a brick can be laid, not a wire can be strung, until the job has first been planned and drawn on paper by a draftsman. Why don't **you** get into work like that? Why don't **you** be a man they can't get along without—a Big Pay Man with a year 'round Big Pay Job? You **can**—it's easy—I'll show you how!

I'll Quickly Prepare You for Drafting

With my new copyrighted "Movie Method," I'll help you get ready for a Big Pay Draftsman's job so quickly you will be astonished. Spare time only needed. With my method—just like "slow motion movies," which are sent to you on printed pages—you **see** how it's done, and you do it yourself almost **automatically.** It's amazingly simple—yet so thorough and complete you learn Drafting from A to Z—learn it so you can sit in with the best of them on the Jobs that pay Big Money.

Sample Lesson FREE

Don't sign up for any Drafting Course until you've investigated my amazing new "Movie Method." Mail coupon for Big FREE Book and Sample Lesson. See my great Earn-while-Learning Plan—see the big Professional Drafting Outfit you get at no extra cost—learn about my Nation-wide Job Service—my positive Money Back Agreement. Mail coupon NOW!

MAIL COUPON FOR FREE BOOK

K. M. Boyd, Chief Drafting Engineer
L. L. COOKE SCHOOL OF DRAFTING
Dept. 081, 2132 Lawrence Ave., Chicago, Illinois.
Send me your book "Draw Big Pay in Drafting" and tell me more about your "Movie Method." This does not obligate me in any way.

Name .....
Address .....
City ..... State .....

ASSOCIATED WITH THE L. L. Cooke School of Electricity IN HELPING THE WORKING MAN EARN MORE MONEY

"GET ON" Uncle Sam's PAYROLL

POST OFFICE CLERKS
CITY MAIL CARRIERS
RURAL MAIL CARRIERS
RAILWAY POSTAL CLERKS
BOOKKEEPERS STENOGRAPHERS
INCOME TAX AUDITORS
CLERKS IN GOVERNMENT OFFICES
at Washington, D.C. and Elsewhere
PROHIBITION INVESTIGATORS

$1260 to $3400 a Year

These are steady positions. Strikes, poor business conditions, lockouts or politics will not affect them. U. S. Government employees get their pay for full twelve months every year. There is no such thing as "HARD TIMES" in the U. S. Government Service.

RAILWAY POSTAL CLERKS

Railway Postal Clerks now get $1900 the first year regular, being paid on the first and fifteenth of each month. $79.00 each pay day. Their pay is quickly increased, $100 and $150 a year, the maximum being $2700 a year. $112.50 each pay day. They get extra allowance for hotel expenses when away from home.

PAID VACATIONS

Railway Postal Clerks, like all Government employees, are given a yearly vacation of 15 working days (about 18 days). On runs they usually work three days and have three days off duty, or in the same proportion. During this off duty and vacation, their pay continues just as though they were working. When they grow old they are retired with a pension. As Railway Postal Clerks are continually traveling, they have an excellent chance to see the country.

"Due to your well prepared training, I received my appointment eight days after your name was placed on the register, D. W. Tucker."

CITY MAIL CARRIERS
POST OFFICE CLERKS

Clerks and Carriers get $1700 the first year regularly, and automatically increase $100 a year to $2100 with further increase to $2300. They also have 15 days vacation. Many February examinations will be held. City residence is unnecessary.

PROHIBITION AGENT-INVESTIGATORS (Open to men 21 to 57) Salary $2300 to $3400 a year. Work connected with the enforcement of the Prohibition Laws.

WHAT WILL YOU EARN 5 YEARS FROM NOW?

Compare these conditions with your present or prospective condition, perhaps changing positions frequently, kicking around from post to pillar, no chance in sight for PERMANENT employment; frequently out of a position and the year's average salary very low. DO YOU EARN $1900 EVERY YEAR? HAVE YOU ANY ASSURANCE THAT A FEW YEARS FROM NOW YOU WILL GET $2700 OR MORE A YEAR, EVERY YEAR?

GET FREE LIST OF POSITIONS

Fill out the coupon. Tear it off and mail it today—now, at once. DO IT NOW—This investment of two cents for a postage stamp may result in you getting a U. S. Government Job.

MAIL COUPON TODAY

FRANKLIN INSTITUTE
Dept. J-326,
ROCHESTER, N. Y.

(Not connected with U. S. Government.)

Rush to me, entirely free of charge (1) a full description of the position checked below; (2) Tell me how to get the position checked; (3) Free copy of 32-page illustrated book "U. S. Government Positions and How to Get Them," with list of positions now obtainable.

- Railway Postal Clerk ... ($1900-$2700)
- Post Office Clerk ... ($1700-$2300)
- City Mail Carrier ... ($1700-$2100)
- Rural Mail Carrier ... ($2100-$3100)
- Clerk in Government Offices ... ($1260-$2100)
- Prohibition Agent-Investigator ... ($2300-$3400)

Name .....

Address .....

Use This Coupon Before You Mislay It—Write or Print Plainly

$1,000 Reward

In a dirty, forlorn shack by the river's edge they found the mutilated body of Genevieve Martin. Her pretty face was swollen and distorted. Marks on the slender throat showed that the girl had been brutally choked to death. Who had committed this ghastly crime? No one had seen the girl and her assailant enter the cottage. No one had seen the murderer depart. How could he be brought to justice?

Crimes like this have been solved—are being solved every day by Finger Print Experts. Every day we read in the papers of their exploits, hear of the mysteries they solve, the criminals they identify, the rewards they win. Finger Print Experts are always in the thick of the excitement, the heroes of the hour.

Not Experienced Detectives Just Ordinary men

Within the past few years, scores of men, men with no police experience, men with just ordinary grade school educations, have become Finger Print Experts. You can become a Finger Print Expert, too. Can you imagine a more fascinating line of work than this? More trained men are needed. Here is a real opportunity for you.

Learn the Secrets of Identification

More and more the detection of crime resolves itself into a problem of identification. You can learn the methods of famous identification experts. You can learn the science of finger print identification—right at home in your spare time.

Send for the free book which tells how famous Finger Print Experts got their start in this fascinating work. Tells the stories of thirteen actual cases solved by Finger Print Experts. Tells how you can become a Finger Print Expert in an amazingly short time.

Rewards and How to Win Them!

This Coupon Brings Full Details
Also Confidential Report Operator No. 38 Made to His Chief

Men just like you have climbed to big success through Finger Print knowledge, gained at home in spare time. Get the thrilling book, telling in stories and pictures of the famous crimes solved by Finger Print Experts. This book is now FREE. Sent prepaid if you just mail the coupon AT ONCE!

University of Applied Science
Dept. 23-S1 1920 Sunnyside Ave., Chicago, Ill.

Mail This NOW for Free Book

University of Applied Science,
1920 Sunnyside Avenue, Dept. 23-S1, Chicago, Ill.

Without any obligation whatever, send me your new, fully illustrated, FREE book of authentic detective tales, "Finger Prints"; also Confidential Report Operator No. 38 Made to His Chief.

Name .....

Address .....

City and State ..... Age.....

Thank You for Mentioning Modern Mechanics When Writing to Advertisers

Talking Shop with the Editors

(*Continued from Page 12*)

And Models? The Wall two-cycle plans given complete in this issue with the exception of the carburetor parts (which will appear in February) will be a treat for the hundreds who wrote concerning the little model aero engine which appeared on page 135 of the November issue of MODERN MECHANICS.

From "Red" Farrelly, New York City, we opened the following note:

> Can you tell me where to get the prints of the little airplane gas motor published on page 135 of the November issue? That type of stuff is published so rarely I wish I could see more of it. It is just harder than heck to be a model enthusiast and not have anything worthwhile shot along to you except how to tie feathers on a clothespin and pretend you're making a big Indian. Stuff like that insults a reader's intelligence. Give us some of the real stuff that isn't "written down" and I bet you'll have an army of subscribers for life.
>
> Yours for Modern Mechanics plans!
>
> Bronx, New York — Red Farrelly.

You are dead right, Red. How would a "Wireless Controlled Model Battleship" sound to you, or "How to Build an Aero Ice Sled"? Coming for February, Red!

A new writer named Gilbert Mickelson bids fair to give our other "how to build" authors a run for their money. Mickelson is a mining engineer for the Oliver Mining Company and has a workshop that is a boon to sore optics. When his story on the "Aero Ice Sled" showed up we contracted for others and you can bet last year's rusty saw that they are going to ring the bell with readers who can handle tools and a slide rule themselves. Concerning one of his articles, Mick wrote:

> I took a little skiff, put an old starting motor in her, and by means of a hook-up I have the temerity to hope you will consider ingenious, I succeeded in producing a very active electric launch from the combination.
>
> Mickelson.

He did! And his article is just another of the treats in store for you, gang! Not only are the "how to builds" we have ready in the files for you the finest that American writers can write, but the most timely features of the day are also scheduled to appear. They will give you the mechanical slants and insights into the little known secrets of everyday wonders. You'll say when you read them, "Wonder why I never thought of that."

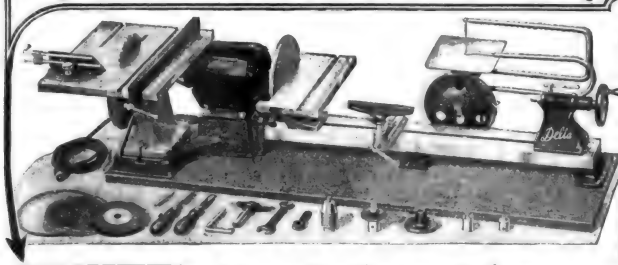
Edgar Rice Burroughs, famous creator of "Tarzan of the Apes," has scored a remarkable hit with his "Conquest of the Moon." Readers who have been wafted from the stern realities of life and who have dwelt in the wonderful moon realm of fancy with Julian and the beautiful young Moon Maid have a new treat in store for them when they take up a new story which starts in the February issue. Concerning the story of Julian's adventures among the Laythens, Jim Pierce writes us:

> Generally fiction of a pseudo scientific nature is done so clumsily that I can get no thrill from it, and I consider most of it bunk! But Mr. Burrough's yarn is sure written by a man who can transport your mind into crazy places and make you breathe hard until you escape! I work at a lathe all day and am pretty much fed up on mechanics at night, but I like the complete kind of news on things you publish, and I sure get a lot of pleasure reading the Burroughs serial. Make him write more.
>
> Yours very truly,
>
> Peoria, Ill. — Jim Pierce.

Just a word in closing, fellows: The letters we get are so enthusiastic and come in such numbers that it is not possible to answer them all. Except where specific information is asked we can only smile a smile of appreciation and send a vote of thanks via mental telepathy. We do wish, however, that all of you would realize that on these articles showing how to build airplanes, motors, and such that we are *not in the business of selling blueprints*, and that many of your questions would be answered by following the series and reading the next issue of the magazine. Of course, there are questions which an article gives rise to, and, of course, you think of them! So do thousands of others. And, fellows, that's just why we've got to sign off and get out that next issue. See you then!

—The Editors.

20 New Big Exclusive Features in the 1929 Model "Delta" Electric Handi-Shop



found **exclusively** in the "Delta" Handi-Shop, in addition to the many regular advantages, include:

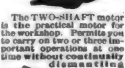
For full details, send coupon below.

Many Exclusive Advantages In This Big Husky Home Workshop

The DELTA Handi-shop is a man-sized motorized workshop, complete, efficient, and PRACTICAL IN DESIGN! Does everything from building full-sized furniture, turning table legs, to finishing delicate detail work. Note the **two-shaft motor** that permits two or **three operations at one time**—the heavy Triple Foundation U-Shaped Lathe Bed (no rods)—the **practical arrangement** of the Circular Saw that permits the cutting of large lumber **without interference**—the Improved Tilting Tables on the Circular Saw, Sanding Disc, and Jig Saw. **Has automatically oiled** bronze bearings and is **completely nacembled** on heavy veneered wood base.

This combination of advantages, plus many more, IS FOUND EXCLUSIVELY IN THE "DELTA" HANDI-SHOP! No wonder even last year's Handi-Shop was an outstanding value. **And now, with the many additional exclusive features of the new 1929 model, this shop is in a class by itself—above all comparison—at a new price that is surprisingly low.**

The TWO-SHAFT motor is the practical motor for the workshop. Permits you to carry on two or three important operations at one time **without continuity dismantling** set-up.



Heavy Triple Foundation U-Shaped Lathe Bed (not rods or rails) is guaranteed not to spring or chatter.

Make the Things You Have Always Wanted to Make

It's so easy and so quick with the Handi-Shop. Save money on repair work. Earn money in your spare time. Complete instructions and Blue Prints furnished. A few of the hundreds of articles you can make with the "Handi-Shop" shown below.

Blue Prints Included

without obligation. See how PRACTICAL, how EFFICIENT is this sturdy, full-sized machinery under actual working conditions. Study its many exclusive advantages. You will find the Handi-Shop complete with all necessary equipment for Circular Sawing, Wood-turning, Jig Sawing, Sanding, Drilling, Grinding and Buffing.

crammed with practical information on how to construct useful and decorative objects. Illustrated.

If you want this book, enclose 10c to cover cost of mailing. See Coupon.

Then if you decide to keep the Handi-Shop, you can have your choice of three convenient methods of payment.

at once for FREE beautifully illustrated literature giving complete description of the **New 1929 Model "Delta" Handi-Shop**, and full details of the 10-day Trial Offer and Convenient Payment Plans.

Delta Specialty Company
Dept. N-19
1661-67 Holton St., Milwaukee, Wis.

Delta Specialty Company, Dept. N-19
1661-67 Holton St., Milwaukee, Wis.

☐ Please send FREE illustrated literature on new Delta Handi-Shop. Also full details of 10-Day Trial Offer and Easy Payment Plans.

☐ Please send me copy of "How to Make Things with a Work Shop." I enclose 10c to cover cost of mailing.

Name .....

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RULES OF CONTEST

1. Twenty-four cash prizes will be paid by Screen Secrets Magazine for the nearest correct identification list of players pictured and the most interesting letter (not more than 100 words) telling which one of these players is your favorite star, and why.

2. It is not necessary to buy any magazine or article to compete in this contest, but as reference past issues of Screen Secrets Magazine may be consulted. Copies may be inspected at Libraries.

3. Contest open to everyone except members of the staff of Screen Secrets Magazine and their families.

4. Contest closes January 10, 1929, at midnight. Prizes will be awarded as soon after the contest as possible. You may send as many sets as you wish but no contestant will be entitled to more than one prize.

5. In case of ties, tying contributors will be awarded duplicate prizes.

6. Send your lists and letters to Screen Secrets Magazine, Box 1757, Minneapolis, Minn., any time before closing date. The editorial staff of Screen Secrets will be sole and final judges.

As a guide in solving this contest, as well as for intimate information about players and pictures of moviedom, read

Screen Secrets Magazine 25c a copy

The January SCREEN SECRETS, now on sale at all newsstands, contains identification of these stars and of many others, with intimate biographies, as well as such exclusive and fascinating features of the movies as—

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A host of other articles with hundreds of beautiful photographs in colored rotogravure. Get acquainted with Screen Secrets! If your nearest newsstand is sold out, send 25 cents in cash or stamps to Screen Secrets Magazine, P. O. Box 1757, Minneapolis, Minnesota.

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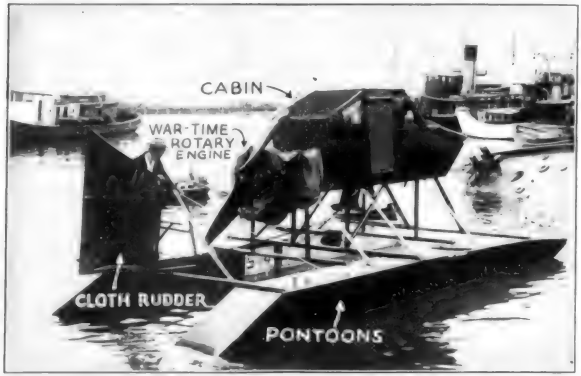

AN UNUSUAL type of surf plane powered with a reclaimed wartime rotary airplane motor has been designed by Sol Messina, of New York. He expects his novel craft to develop a top speed of 85 miles an hour.

As the above photo shows, the surf plane is of light but sturdy construction. Pontoons and cabin are made from tin, the former being made watertight to support the weight of the ship. A cloth rudder at the rear serves to steer the craft. The rotary engine was salvaged at a cost of $50, affording a cheap but dependable power plant. An unusual feature is the mounting of the engine at the rear of the boat, where it pushes rather than pulls the plane. Cabin and engine are supported by steel tubing of the type used in building airplane fuselages. The photograph shows the surf plane in New York harbor, where tests are being conducted.

EIGHTEEN-INCH PACKING CASE HOLDS CONTORTIONIST

This contortionist takes a little nap in an 18-inch packing case.

CAN YOU wedge yourself into a packing case only a foot and a half square? The feat sounds impossible, but it is only an incident in the day's work for a Berlin contortionist. The photograph shows him tied into a knot inside his narrow quarters, with his assistant looking on. Just how comfortable his position may be, is open to question, but it is at least certain that there is very little space inside the box that is not occupied by the actor. According to the contortionist, there's nothing to the feat. He's the ideal type of renter for a kitchenette apartment.

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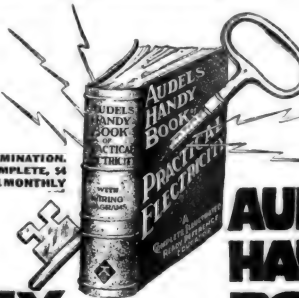

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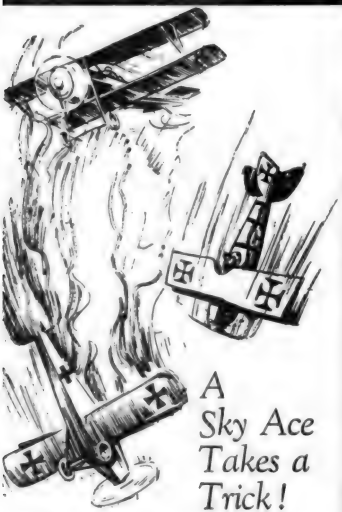

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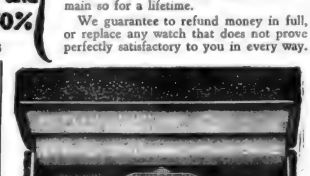

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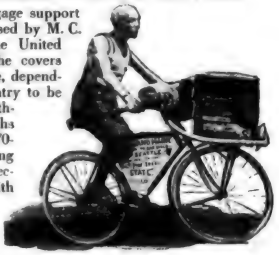
AMONG the treasures which have been accumulated for centuries by the conquerors of Turkey is the unique and world-famous throne of Shah Ismail of Persia, shown in the above photograph. Pearls, rubies, sapphires, and other precious gems incrust this priceless piece of furniture, which is estimated to be worth $10,000,000. There are over 22,000 individual gems joined together to form the intricate patterns on the legs and sides of the throne. In addition to the value of the gems themselves, the extremely delicate work of inlaying the stones gives the throne an added value. It is estimated that it required about 25,000 hours to complete the inlay work, for settings had to be carved for the stones and each gem fastened with cement.

The footstool, which is separate, from the throne, has a value of a million dollars.

70-YEAR OLD TOURIST CROSSES U. S. ON BICYCLE

AN ORDINARY bicycle with a special baggage support above the front wheel is the equipment used by M. C. Plummer of Portland, Maine, in touring the United States. Mr. Plummer is 70 years old but he covers from 50 to 150 miles every day on his bicycle, depending on the weather and the nature of the country to be traveled. The sack of bedding, food and clothing which he carries on his handlebars weighs 80 pounds but is so well balanced that the 70-year old tourist has no difficulty in controlling his two-wheeled automobile. Mr. Plummer recommends this system of traveling as a health builder. He does not try to cover any specified distance each day, but sleeps wherever he happens to find himself at sunset.



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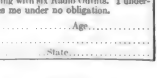

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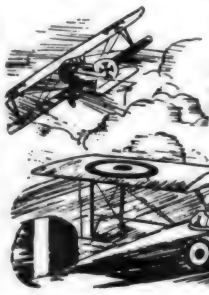

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A Wonderful Business

Real estate—conducted my way—is a great business. It is as permanent as the earth itself. It is getting bigger and bigger as the country grows. It doesn't require years of study to learn like most other businesses and professions. It offers enormous earnings to ambitious men and women. Users of my system are making $1,000—$5,000—$10,000—on single deals—as much as the average man gets for months and years of hard work. And the business is practically unlimited. Ten million properties are now on the market for rent, sale or exchange. And you can start with little or no capital—right at home in your spare time. I did. So did others. So can you. My free book tells you how.

Read These Records

Here are just a few brief extracts from the many letters received from happy users of my money-making real estate system:

"Made $5,500 on first deal after getting your system.—Mrs. Evalynn Bulster, Chicago *(Former School Teacher)*. "Sold a lot by your method in less than one hour and my commission was $300."—J. A. Furguson, Fort Lauderdale, Fla. *(Former Dry Cleaner)*. "Sold over $100,000 worth of property my first year with your methods."—H. D. Van Houten, Passaic, N. J. *(Former Grocery Clerk)*. "Have sold thousands of dollars worth of property your way. Have deals that will go beyond the $300,000 mark."—Carrie Marshall, Ocean Springs, Miss. *(Former Housekeeper)*. "My first day's work in real estate netted me $435. I recommend your system to anyone wishing to get into a pleasant and profitable business."—F. B. Bennett, San Diego, Cal. *(Former Planing Mill Man)*. "Have sold one $5,000 lot and 4 houses so far, with your system."—Mrs. B. H. Morehouse, Brooklyn, N. Y. *(Former Housewife)*.

These are just a few samples of success that you will read about in my free book. Get it. Read it. Follow its instructions. Make big money my way.

Get Free Book Now

My big, new, illustrated book is filled with fascinating facts about my kind of a real estate business—what I did—what others are doing—what you can do.

Mail coupon right now and get this valuable, money-making information free. It doesn't cost you a nickel to find out what this book can do for you. So act at once. You will never forgive yourself if you turn your back on this unusual chance to win big business success. Address PRESIDENT, American Business Builders, Inc., Dept. 381, 18 East 18 Street, New York.

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Here's the proof that this is the biggest money-making opportunity of all: ONE THOUSAND DOLLARS IN GOLD will be paid to anyone who shows us any other business course of any kind that has helped as MANY men and women make as MUCH money in as SHORT a time as our remarkably successful Real Estate Course.

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Mail me your free book, telling how you made $100,000 in a new kind of real estate business—how others are making big money—and how I can do the same.

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Walking on Wheels is the Latest European Sport

THE newest aid to the pedestrian is the "paticycle," invented by a Frenchman as an easy and inexpensive means of getting from here to there. The device consists of wheels attached to the walker's feet and legs by means of braces. It is operated by swinging the legs forward as if walking on the ground, but the feet never touch the road. A staff is carried in each hand to steady the walker and help him steer a straight course.

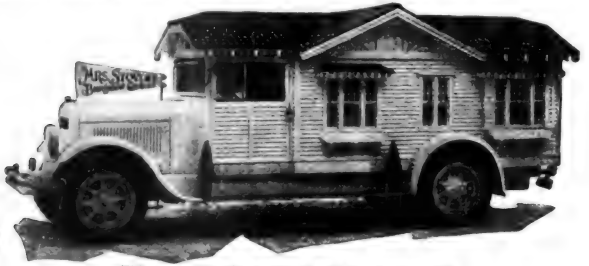
A paticycle race was recently run from Versailles to Paris. Charles Samuel, the winner, is shown crossing the finishing line.

WAR WAGED ON DUST

FLYING particles of dust in offices and factories have been branded by medical science as the cause of many diseases, particularly those of nose, throat, and lungs. Dust of animal and vegetable origin—from cotton, flour, wool, and wood—give rise to asthma, catarrh, and bronchitis. Dusts that are free from silica are comparatively harmless. Particles of dust must be smaller than one forty-thousandth of an inch in order to enter the lungs.

CANDY TRUCK IS BUNGALOW ON WHEELS

A PERFECT reproduction of a bungalow, complete with porch, window boxes, tile roof and gables, has been mounted on a truck body by a Chicago candy manufacturer to serve the double purpose of delivery and advertising. Both truck and bungalow are finished in white enamel with the tiles of the roof in red, presenting a striking appearance as the novel machine drives through the city streets. The bungalow windows are fitted with glass and they open and close precisely as they do in a real house. Green potted plants on either end of the running boards lend an added touch of color to the bungalow truck.



This novel advertising stunt is said to pay very well.

DRAFTING!

Learn at Home

Drafting is one of the best professions a young man can choose because it pays good salaries and it is the stepping stone to even better positions. Many leading architects, mechanical engineers and electrical engineers got their start at the drafting board.

There is no easier way to learn Drafting than through the home-study courses of the International Correspondence Schools. The practical value of these courses is shown by the success of I. C. S. students and also by the fact that employers are constantly writing us for trained men. We receive more calls for I. C. S. draftsmen than for graduates of any other course.

F. E. King was "a poorly paid clerk" when he enrolled for the I. C. S. Drafting Course. By study, industry, and perseverance he became Chief Draftsman of the U. S. Steel Furniture Company, of Syracuse. He is now earning more in a day than he used to earn in a week.

A. J. Hutchins became Chief Draftsman for the American Strawboard Company and increased his salary 300 per cent—also as a result of I. C. S. Training.

There is no doubt that Drafting offers a real opportunity to ambitious men and it will pay you to investigate it. Just mark and mail the coupon and we'll gladly send you a booklet telling all about the I. C. S. courses in Drafting or other subject in which you are interested.

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Without cost or obligation on my part, please send me one of your booklets and tell me how I can qualify for the position or in the subject before which I have marked an X:

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☐ Architectural Drawing	☐ Illustrating and Designing
☐ Mechanical Engineer	☐ Machinist
☐ Electrical Engineer	☐ Toolmaker
☐ Civil Engineer	☐ Iron and Steel Worker
☐ Steam Engineer	☐ Patternmaker
☐ Structural Engineer	☐ Foundryman
☐ Architectural Engineer	☐ Automobile Mechanic
☐ Surveyor	☐ Architect's Blueprint Reading
☐ Concrete Builder	☐ Electrician
☐ Contractor and Builder	☐ Apprentice Trades
☐ Business Management	☐ Salesmanship
☐ Traffic Management	☐ Advertising
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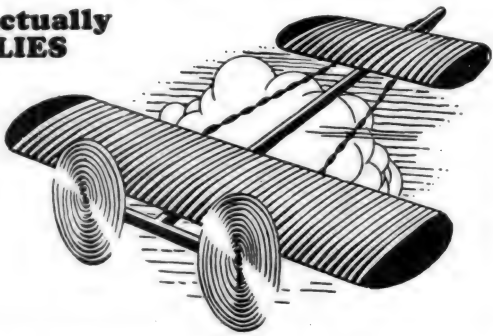
FREE! A Real Model Airplane

Actually FLIES



Here is the famous Red Bomber Combat Model Airplane. Has specially made fibre wings, two cleverly fashioned propellers, two powerful rubber motors. No sport on earth like flying model planes. Order your plane today. Then, send it into the air zipping and zooming, banking and turning, then soaring to greater heights. Watch the crowd gather. Hear the applause. Here's how you can get it free.

A Whole Year of Breathless Reading

The Open Road for Boys Magazine has 50 pages a month crammed with breath-taking fiction, thrilling stories of high adventure on land and sea, mystery, daring, stories of the war, of aviation, of sport. Many departments and prizes for all. Nothing to compare with these stories. Regular subscription price $1 a year. We will send you the Red Bomber Plane and a whole year's subscription —12 issues—to The Open Road for Boys Magazine all for $1.

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Sure fire! Here's my dollar. Rush me the Red Bomber Plane and put me down for a whole year's subscription to The Open Road for Boys Magazine.

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How Strong Are You?

Can You Do These Things?

Lift 200 lbs. or more overhead with one arm; bend and break a horseshoe; tear two decks of playing cards; bend spikes; chin yourself with one hand

CAN you do any of them? I can and many of my pupils can. It is remarkable the things a man really can do if he will make up his mind to be strong. It is natural for the human body to be strong. It is unnatural to be weak. I have taken men who were ridiculed because of their frail make-up and developed them into the strongest men of their locality.

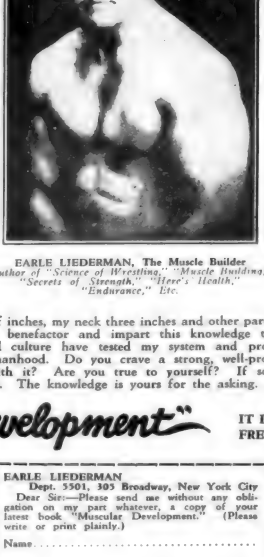
I Want You for 90 Days

These are the days that call for speed. It once took four weeks to cross the ocean—now it takes less than one. In olden days it took years to develop a strong, healthy body. I can completely transform you in 90 days. Yes, make a complete change in your entire physical make-up. In 30 days I guarantee to increase your biceps one full inch. I also guarantee to increase your chest two inches. But I don't quit there. I don't stop till you're a finished athlete—a real strong man. I will broaden your shoulders, deepen your chest, strengthen your neck. I will give you the arms and legs of a Hercules. I will put an armor plate of muscle over your entire body. But with it come the strong, powerful lungs which enrich the blood, putting new life into your entire being. You will be bubbling over with strength, pep and vitality.

A Doctor Who Takes His Own Medicine

Many say that any form of exercise is good, but this is not true. I have seen men working in the factories and mills who literally killed themselves with exercise. They ruined their hearts or other vital organs, ruptured themselves or killed off what little vitality they possessed.

I was a frail weakling myself in search of health and strength. I spent years in study and research, analyzing my own defects to find what I needed. After many tests and experiments, I discovered a secret of progressive exercising. I increased my own arms over six and a half inches, my neck three inches and other parts of my body in proportion. I decided to become a public benefactor and impart this knowledge to others. Physicians and the highest authorities on physical culture have tested my system and pronounced it to be the surest means of acquiring perfect manhood. Do you crave a strong, well-proportioned body and the abundance of health that goes with it? Are you true to yourself? If so, spend a pleasant half hour in learning how to attain it. The knowledge is yours for the asking.



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Author of "Science of Wrestling," "Muscle Building," "Secrets of Strength," "Here's Health," "Endurance," Etc.

SEND FOR MY NEW 64-PAGE BOOK

"Muscular Development"

IT IS FREE

It contains forty-eight full page photographs of myself and some of the many prize-winning pupils I have trained. Some of these came to me as pitiful weaklings, imploring me to help them. Look them over now, and you will marvel at their present physiques. This book will prove an impetus and a real inspiration to you. It will thrill you through and through. This will not obligate you at all, but for the sake of your future health and happiness, do not put it off. Send today—right now, before you turn this page.

EARLE LIEDERMAN

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Dear Sirs:—Please send me without any obligation on my part whatever, a copy of your latest book "Muscular Development." (Please write or print plainly.)

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You are personally guided and helped by practical engineers and educators, including: Bruce Rogers, M. S., Western Electric Company; J. A. Shimek, M. E., DeVry Corporation; A. P. Hollis, formerly Director Visual Education, University of North Dakota; W. N. Littlewood, formerly instructor University of Wisconsin, and others.

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Standard Model DeVry motion picture Projector, value $75.00, and thousands of feet of film, supplied to every student for use during the course at no extra cost. So simple anyone can operate it, immediately. Uses ordinary light connection, farm lighting equipment, or automobile battery. ***Gives clear, brilliant, flickerless movies right in your own home.***

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Complete professional outfit, including the set of fine instruments in plush lined case shown here, and in addition drawing board, rules, T-square, scale, paper, etc. Everything that is necessary for this ***complete course in electricity with drafting,*** at no added cost.

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Charles E. Fitz, M. E., E. E., formerly associated with Steinmetz, says: "I am amazed at how clearly and simply you explain the facts about electricity. The points are ***so much easier to grasp*** than by the usual methods of instruction that ***the student must make quicker, surer progress.***"

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Mail this Coupon At Once!

Everybody a Builder!

ONE OF THE fundamental urges in the soul of every man is the urge for self expression.

In some men it is music which touches a responsive chord, and these men find satisfaction in playing a musical instrument. In others, sports afford an outlet for self expression. Still others turn to mechanics and science as a means for satisfying the urge to create.

In this latter group of creative men are scientists, mechanics, machinists, and mechanically minded men and boys of all ages. It is a noticeable fact that in men with mechanical trends of mind creative ability exists to a marked degree.

Men who possess this faculty of being able to turn the "stuff that dreams are made of" into tangible realities are the men who will be the leaders of the nation tomorrow. History is replete with instances of young men, who, puttering in an attic, discovered a mechanical means for making life easier for untold millions.

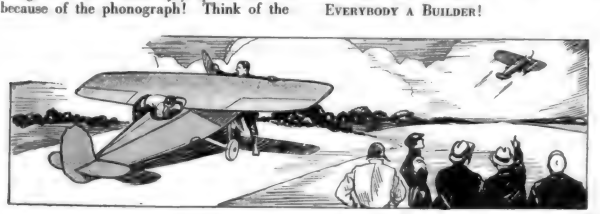
Take the classical case of Thomas Edison, whose name is a synonym for invention. When a youth, working on railroad trains, Edison became engrossed with the mysteries of electricity. He rigged up a workshop and by training his mind in the study of electricity, found that in later years he had stored up a wealth of data on experimenting which enabled him to put his finger on exactly the hook-ups he needed to prove the theories his shop-trained mind had evolved. As a result of his experimenting and building, think of the untold millions of human beings who are able to enjoy operatic music because of the phonograph! Think of the benefit mankind has received because of the fireless instantaneous light shed by Dame Mazda! Behind these achievements is the training of mind and hand which was given Edison by his early workshop "puttering."

Napoleon was considered queer in his cadet days because he preferred to play with toy soldiers, marshalling them in different formations to work out theories in military tactics. Ostracized, believed even to be feeble-minded by his military school confreres, he was in later years able to so effectively place a single gun at the mouth of a besieged harbor that he kept the entire British Navy at bay. This stratagem baffled and chagrined Lord Nelson to his dying day, and restored French confidence in Napoleon's brilliance at a crucial time. Behind this incident was the training given Napoleon by his "puttering" of early years.

It is the aim of the Editors to present the kind of amateur building projects which not only delight the spirit of play which is in every mother's son of us, but which are at the same time mature enough projects to teach us things which will mold our abilities to analyze, to plan, and to execute.

Get a workshop! Build that idea for a motor you've had in mind! The dividends resulting from self expression in the building of things mechanical are incalculable! You will find you are a part of a vast army of "putterers," the excellence of whose output is astonishing; an army which will graduate men from the school of hard knocks who will tomorrow be reaping the rewards that come to men who guide the destinies of the nation!

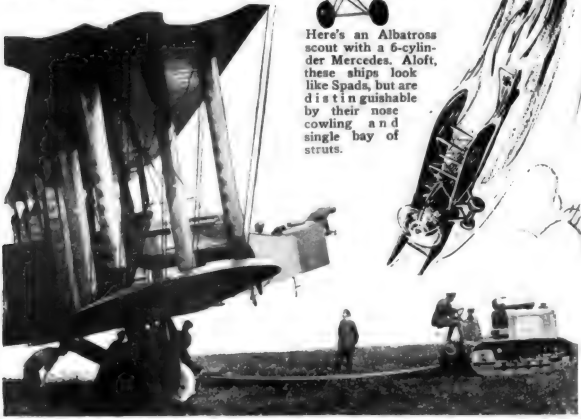
EVERYBODY A BUILDER!



War FIGHTING

Powered with an 8-cylinder 180 H. P. Hispano-Suiza, the Spad was capable of close to 130 m. p. h. As shown above, she was a favorite with pilots in the last year of the war.

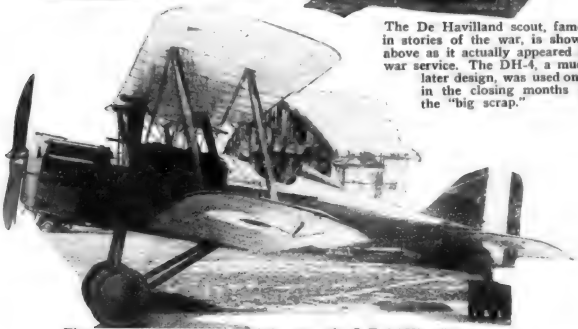
Here's an Albatross scout with a 6-cylinder Mercedes. Aloft, these ships look like Spads, but are distinguishable by their nose cowling and single bay of struts.



The Handley-Page designed bomber shown here was powered with two 450 H. P. Rolls Royce engines, had a wing span of 105 feet and was an enormous load carrier. The Germans copied the design later in the Gotha Bomber with which they bombed London.

PLANES

The De Havilland scout, famed in stories of the war, is shown above as it actually appeared in war service. The DH-4, a much later design, was used only in the closing months of the "big scrap."

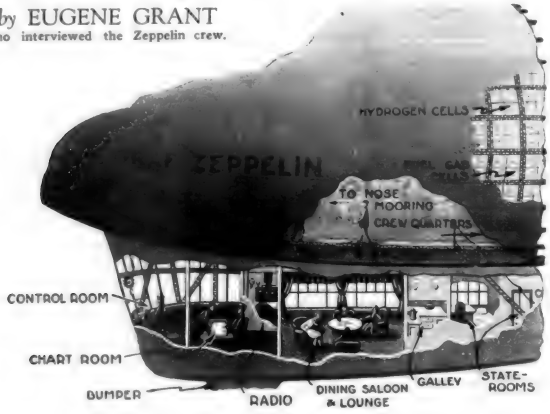


The most maneuverable ship of the war—the S. E. 5, "Hisso" powered.

A clipped wing version of the early Bleriot monoplane, using 18 h. p., was used at the start of the war in training aviators. The idea was to put a green pilot into a plane which couldn't fly, and let him get the "feel" of the controls by himself!

Crew RISKED LIVES to

by EUGENE GRANT
who interviewed the Zeppelin crew.



BUFFETED by the wind, with a torn fin, the Graf Zeppelin faced destruction unless the damage could be repaired. Here is the inside story of how the daring crew climbed onto the fin and saved this giant from destruction.

LITTLE has been told of that remarkable feat performed by the crew of the Graf Zeppelin in repairing the port horizontal fin damaged by the storms and threatening the destruction of the great air liner on the first passenger trip by air to the United States.

I learned what happened at Lakehurst, when the tired crew was landed. As a mechanical achievement, the repair of the fin is outstanding, for the men worked high over the ocean, at the risk of their lives, to cover the bare metal and prevent further damage to the fin, without which the Zep would have been driven helplessly before the wind.

This is what happened: Passengers were eating breakfast, happily chatting, when suddenly a vicious squall struck the ship. The nose of the liner dove, and as suddenly raised again.

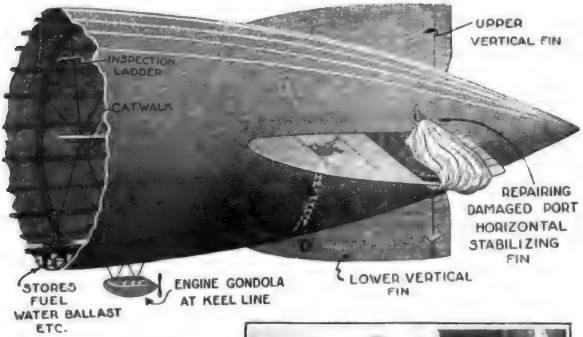
When order was restored, it was found that the stabilizing fin on the left side had been ripped open, and the silver covered fabric hung in shreds.

Instantly Commander Eckener ordered the engines stopped. If the wind ripped more of the covering off, the stabilizer was useless.

Up through the dark interior of the great liner went three of the crew. A ladder led the way to the point where the fin girders were attached to the hull.

With ropes around their waists to prevent their plunging into the ocean, Navigator Marx, Chief Engineer Ziegle, and

Repair GRAF ZEPPELIN



Showing the general construction of the Graf Zeppelin (not in proportion) and the fin where the crew risked death to make repairs in mid air. The stabilizer, vital to the control of the liner, was almost stripped of its fabric during a storm.

Photo shows the fin as it looked in the hangar at Lakehurst, where it was re-covered before making the return trip to Germany.

Knute Eckener, the son of the Commodore of the ship, began their hazardous work. Cords were passed to them, and they first bound the flapping fabric to the girders.

The job seemed hopeless. At a word from the Commodore, the radio operator began sending the distress signals. If the fin gave way all might soon be plunged into the sea. It was a trying moment.

Another squall was coming up. They must start the engines again and get out of its path or suffer certain destruction.

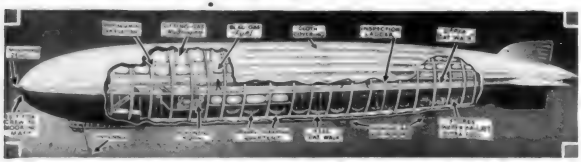
Commodore Eckener's son was out there on the fin—would the speed of the ship and the force of the wind blow him off—and his fellows? The Commodore could not hesitate. He gave the order to go forward with two of the motors. No warning could be given the crew on the fin.

The ship surged out of the storm, and the men worked on, wet, cold, clinging to their ropes, but making headway with the job. For three hours they wove the fabric together, patched on new pieces, and fought to keep the fin together. The call for help was cancelled.

All night they stood by, ready to go out onto the stabilizer again if the wind should again tear off the fabric. When morning came the goal was in sight—they had won! The most epochal voyage in history had been made.

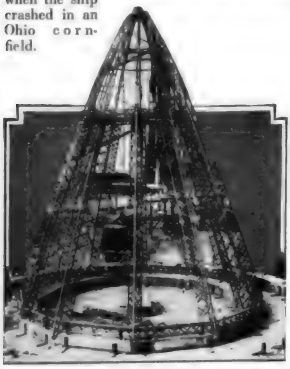
High above the stormy waters of the ocean the greatest airship ever built rode magnificently forward to — America, at seventy miles an hour.

Construction Details of Graf Zeppelin Shown by Skeleton View



Drawn to proportion, this sketch shows the various parts of the great ship that carried 60 people and freight a distance of 6,300 miles in 112 hours—the longest trip ever taken without landing, and the first passenger journey by air from Europe to America. The ship is 770 feet over all, or 110 feet longer than America's Los Angeles, and her diameter is 100 feet. Maximum speed is 80 miles an hour.

The accident was not as bad as it might have been. The squall which struck the *Graf Zeppelin* is the same type of quickly rising gust which wrecked the dirigible *Shenandoah* one dark night in 1924 as that daughter of the stars was over Ohio enroute to the Northwest. The squall which foundered the *Shenandoah* broke the airship in two and killed several members of the crew when the ship crashed in an Ohio cornfield.



Showing the stream lined, parallel girder construction of the Graf Zeppelin. Each duralumin girder is a polygon, and is trussed and braced with tie rods.

The Graf proved that her hull was strong enough to survive such "twisters." The worst that happened was the ripping off of the cover on the fin, which, serious as it was, could easily have imposed strains which would have buckled a main longeron.

Here again Eckener's genius manifests itself. Had a girder buckled, it was so designed that the distorted members could have been removed. The new straight pieces would have been bolted into place, and the damage repaired right in the air as was the repair to the fin! What a marvel of forethought the *Graf's* design is!

The king of the sky followed a path over the seas traversed by that earlier group of adventurers under Christopher Columbus. The air journey is equally hazardous and daring. It also became an epochal Transatlantic Crossing. But this modern Columbus, the *Graf Zeppelin*, is not manned by a crew afraid of dragons, of sailing to the end of the world—to the unknown.

Men of courage who had braved the black North Sea to risk their lives in dropping bombs on an enemy, men who had given years of their lives to the fight for victory of science over nature, virtually men of steel, controlled and directed the first commercial airship. Chief among them is their Commodore, Eckener. Eckener, genius of scores of Zeppelins, and pilot of the Los Angeles on its flight to the United States, not only brought his ship through storm and danger to America, but in a fortnight added to his achievement by making the return trip to Germany.

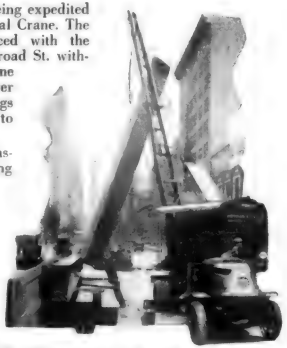
Truck Crane Materially Aids Subway Construction

SUBWAY construction in Philadelphia is being expedited by means of the 7½ ton capacity Universal Crane. The Heyman and Goodman Company were faced with the problem of constructing a new Subway on Broad St. without obstructing traffic. They found that a crane of this type with a 32 foot boom could lower all the structural steel through small openings in the loading deck without closing the street to traffic.

The crane is mounted on a Mack Truck chassis which has special braces to relieve spring load while the crane is lifting, but which can be retracted to allow the whole outfit to move.

Such construction aids as this crane allow the engineer a much greater scope of operation than he has ever enjoyed. Since time is the essence of all contracts, such a crane makes possible a speed that has never before been attained in certain types of building.

Portability of the crane is a feature which particularly recommends its use.

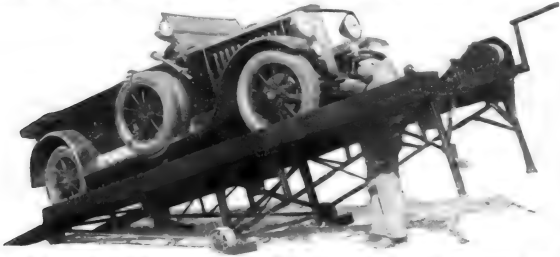


This 7½-ton crane is lowering a steel beam into a new subway.

SELF-CONTAINED PORTABLE SERVICE RACK

BUILT on the principle of a teeter-totter, this German contrivance for servicing motor cars greatly facilitates the ease with which the lower parts of the chassis may be cleaned and greased.

Being portable, operators who own the stand may transfer their business from place to place. It consists of an inverted kingpost truss on which are mounted channels for the wheels. At one end of the drive is a worm-driven winch for raising up the incline. Extension legs hold the rack in position. The photograph shows how the device is operated.

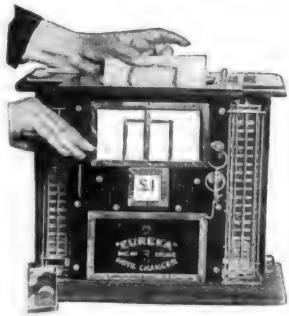


This steel service rack was recently introduced in Germany. A winch for raising the car onto the incline and wheels for transporting are features which are cleverly incorporated to make a complete service unit out of the old-time rack.

Money Changing Machine Gives Silver for Bills!

MANY times has the cash girl wished that she didn't have to change paper money and run out of change. Realizing this, an English inventor conceived and produced a changing machine. The bank note is placed within a flap on the top of the machine and the lever pressed downward. The exact change is then delivered to a cup at the bottom. A one pound English note is the only one that can be used in this particular model, but no doubt the inventor will fit the idea to several other types of currency.

The American cigarette vending machine is similar to this device. It has relieved the cash girl greatly, but there is still much congestion along this line. Modern invention is producing labor saving devices so fast that we often wonder just what will be next.



MANHATTAN'S NEWEST GIANT BUILT IN RECORD TIME

NEW YORK'S new structural pride is the Chanin Building, which is to be completed Jan. 1, 1929. The structure is 680 feet high, or about 70 below the height of the Woolworth Building, but its 56 floors top the Woolworth by one in number. The most remarkable feature of the building is the manner in which the architect has utilized the floor space. Usually tall buildings have reached such tower-like proportions by the time the top floors are reached, that the rentable floor space is small. The Chanin Building, however, maintains usable offices to the very top. The total floor space is 825,000 square feet; of that more than 700,000 square feet is rentable. Considering the extreme height of this building, these proportions are very good. The architect very cleverly fitted the design of the building to be in keeping with surrounding buildings. Note how the main "steps" are all concentrated at that point where the other tall structures reach their greatest height. The building is a remarkable feat in itself, but the speed with which the constructing engineers have erected it is still more remarkable. The first steel column was raised on the 23rd of Jan., 1928, and the building is to be ready for occupancy before Jan. 1, 1929. When one realizes the height at which this structure raises above the street level which is the place at which all material must have been received, it makes the speed record all the more startling, for every piece of steel and stone must have been lifted into place.

Famous Flier Builds Two-Wheel Automobile

FAMOUS English flier and pioneer of British aviation that he is, Mr. A. V. Roe has always been first to experiment with novel forms of transportation. Recently he appeared on the roads in Great Britain in a queer two-wheeled automobile which is powered with a three-horse power air cooled motorcycle engine driving the rear wheel through a geared shaft instead of the usual chain.

Steering is accomplished in a manner similar to the drag link system used on most automobiles. The novel two-wheeled car has a body containing an upholstered seat on which the driver comfortably reclines.

There is also a windshield and ample protection from the slush of the streets by reason of the very cleverly designed body. This car is the result of the great cry for light, efficient motor cars which has so engrossed the people of Europe since the war.

This three-horse power auto type motorcycle can develop better than a mile a minute!

IT DOESN'T HURT A BIT

Dr. M. E. Moby, of Los Angeles, found his canine patient more unconcerned than a human patient when he used his dentist's drill to make way for a new inlay.

OLD WATER PIPE MADE OF WOOD

THIS relic of bygone days in Chicago was recently unearthed when workmen digging the excavation for a power plant came across a length of wood pipe. Made of logs drilled through the center and reinforced by iron bands, the bore was lined with copper sheeting rolled into a tube. John Walsh is shown above with some of the lengths and a piece of the copper tubing. The wooden pipe is no longer used, but the idea of non-corrosive copper for long life water pipe is present day practice.

Nose Printing

By WALTER COOK

CATTLE rustlers can't change brands and steal cattle now! A fingerprint expert has found a way to prove identity of animals by recording their noseprints as told in this article.

CATTLE rustlers of the western plains are likely to bump into a "peck of trouble" when they run off expensive prize cattle in the future, due to the adoption of animal noseprint records which cannot be counterfeited like ordinary brands. The unscrupulous cattleman of the past was an adept in blotting brands, but the nose print system promises to make the rustling business permanently unprofitable. So does modern science take a jolt at the romantic branding-iron!

Cattle, of course, are not the only animals which can be infallibly identified by this new system developed by Frederick Sandberg, fingerprint expert of the District of Columbia police department.

To make nose print records of your favorite dog, horse or cow is such a simple process that the average owner can readily reproduce satisfactory ink records of the peculiar bumps, lines and markings on the nose of each animal.

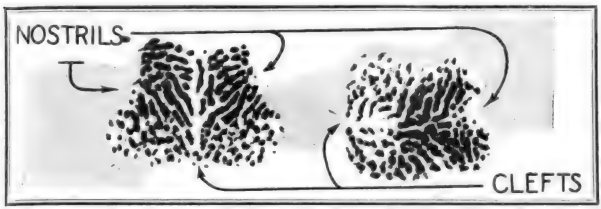
Suppose that you own a valuable bull-dog which you desire to nose print. As the dog perspires freely through the pores of his nose, you must wipe his nose dry with a flannel cloth just before applying the ink. Then press an ordinary rubber stamp pad against the animal's nose. As quickly as possible after the application of the ink, press a small board upon which you have fastened a sheet of mimeograph or newsprint paper against the dog's nose, beginning with the lower edge of the paper at the base of the upper lip and rolling toward the face.

The impression must be made hastily after the ink is applied as otherwise the flow of perspiration will result in a smeared print or record. Smooth finish paper is not satisfactory for making such records because of its poor absorptive qualities which result in badly blurred or blotched reproductions. Black rubber stamp ink has proved most satisfactory for dog and live stock identification records. Ordinary ink such as used in fountain pens is unsatisfactory, as it runs after being applied to the animal's nose. Blue or red pad inks are not as satisfactory as the black ink because they do not

Nobody can lead this kind old bossy-cow away from her owner now! Her nose print is as good an identification as a man's fingerprints. Bossy is shown here placidly signing her "snooty" signature to farm ownership records.

Animals' Noseprints Show as Much Variety as Human Fingerprints

Proves Pedigrees



Criminals' fingerprints? No! Just nose prints of two new born calves who wobbled about while their noses were dried and the ink applied. The difference between individuals is not apparent to the eye until prints of the nose markings are compared. These calves, twins to the eye, are as different as night and day, as the print shows. Note the difference in nostril size and cleft placing.

produce such clear-cut contrasts and are more difficult to photograph.

The detailed study of some 500 noseprints of cattle has demonstrated that the nose peculiarities of no two animals are exactly alike. Each record is distinctive and easy to recognize because of the differences in the glands underneath the skin, causing more or less pronounced elevations and forming irregular lines as grooves between such elevations. On some animals these elevations are less pronounced than on others and hence they are called "smooth noses" by the nose print specialists. Care has to be exercised in making the nose prints of such smooth-nosed animals, for if the inking pad is pressed too hard against the proboscis the resultant print will be so smeared as to be valueless.

The nose patterns remain the same throughout the life of the animal even though it lives as long as the aged elephant, Methuselah of the jungle kingdom. The nose of your dog, cat or prize purebred calf enlarges slightly as the animal grows but no change in the type or pattern of the nose markings occurs.

Nose print records are of value to the various breed associations in the dog, cat and cattle worlds. Such identification data are invaluable in proving legal ownership when animals stray, get lost or are stolen. Unscrupulous owners sometimes substitute living animals of much lower value for costly purebreds that have died, and subsequently sell the masqueraders as registered stock at fancy prices. Live stock insurance officials report that they have paid claims where they were positive that illegal substitution of ordinary for valuable ani-

Valuable pedigreed pets can now be kept with the assurance that absolute identification can be made in event of loss. Here a bull terrier is being "registered."

Infallible Records Provide New Rogues Gallery of the Animal World

Difference in Mouth Structure Also Offers Means of Identification

mals had been made. No infallible method of identification then existed and these authorities could not prove their contentions in court. Similar riddles no longer complicate pet and live stock transactions, for animal nose prints invariably detect such frauds and result in the punishment of dishonest offenders.

The finger prints of a monkey's hand are so similar to those of a human being's that it is rather difficult to distinguish between them. Because the monkey makes more extensive use of his hands in climbing and walking, the fingerprint specialist has observed certain peculiarities which now aid in differentiating between the fingerprint records of men and monkeys.

French scientists are engaged in research which seeks to discover supplementary methods of human identification to the fingerprint system now used unanimously by American police departments and our Army and Navy. The French are carrying on detailed experiments with the idea of identifying criminals by the differences which exist in the pores of their skin. This new system of identification, if it is perfected eventually, is much more complicated than the fingerprint method, and will necessitate the employment of experienced scientists as police department aids. It features the technical intricacies of photomicroscopy as the dependable aids of modern detection and identification.

American dentists at various times have suggested the making of plaster impressions of the roofs of the criminal's or animal's mouth for identity purposes. Such methods although efficient would involve the maintenance of too many bulky models which in time would accumulate in state, city and federal archives by the million. Science can readily recognize one man or animal from others by the individual peculiarities of mouth structure. Such system of identification is impractical, however, because of the untold tonnage of specimens which would have to be made and preserved.

BRIDGE RAIL SPEARS SKIDDING AUTOMOBILE

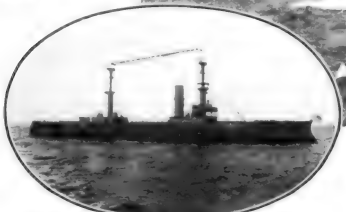
When the driver of this automobile skidded on a slippery highway bridge, his car picked up the top rail of the bridge as shown in the photograph below. The two-by-four pierced the engine hood, penetrated the vacant seat at the right of the driver, and came to a stop at the rear of the car. Fortunately there was no one riding with the driver at the time of the accident and nobody was injured.

This auto driver came within an inch of eternity when his car skidded and impaled itself on a bridge rail. No one was injured.

Radio Controls Warships

A battleship without a man aboard is maneuvered by radio in trial tests!

Above is the ship's bridge from which the radio signals were sent which controlled the movements of the German cruiser, Zahringen. The arrow at the right points to the control ship.



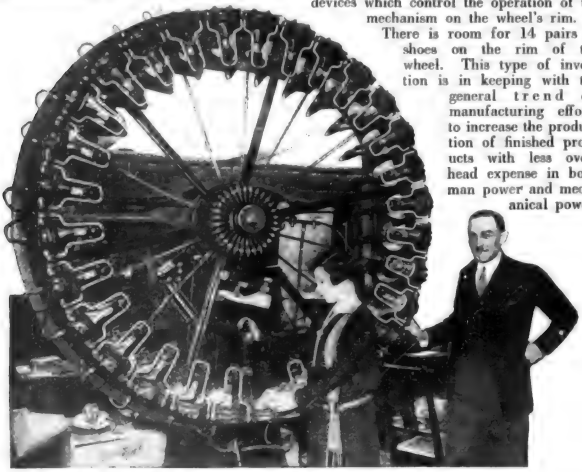
Here the Zahringen is shown just after it came to a stop after the tests. Note the wireless antenna through which the control signals pass.

The photo above shows the Zahringen enveloping itself in a smoke screen in response to radio signals from the control ship. The battleship starts, stops, turns, and regulates its speed as the radio operator directs. There is not a human being aboard the ship shown in the picture traveling at top speed.

New Machine Makes 600 Shoes in Eight Hours

SIX HUNDRED pairs of shoes in eight hour is the record set by the new shoe manufacturing machine recently exhibited at the Leather Fair in London, shown in the photo below. It resembles a gigantic wheel, the spokes of which contain the electrical devices which control the operation of the mechanism on the wheel's rim.

There is room for 14 pairs of shoes on the rim of the wheel. This type of invention is in keeping with the general trend of manufacturing efforts to increase the production of finished products with less overhead expense in both man power and mechanical power.



NEW TELEPHONIC DEVICE KEEPS HANDS FREE

MR. GEORGE TANKARD is shown below with his new invention that is designed with an eye to speeding up the efficiency of a busy man. This invention is balanced on the shoulder by the form fitting holder. The receiver is placed in the holder and then adjusted to the shoulder so that the ear gets the best results. It is interesting to note that this device has been produced in London, where the American type of speed efficiency has been taking a very strong hold in the last few years.

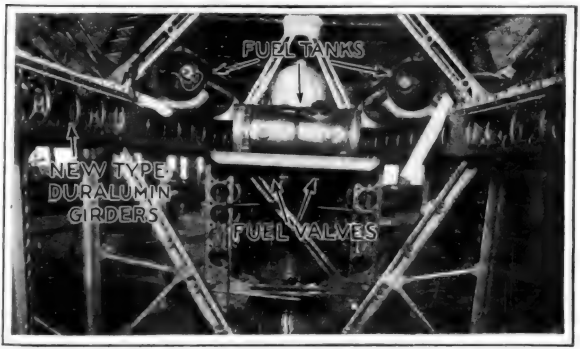
Explorers seeking to realize the common bonds that exist between them organized a club on May 28, 1904, under the leadership of Henry Collins Walsh. It was known as the Explorers Club. The club has at last reached a permanent stage, for they are erecting a club house at 544 Cathedral Parkway, New York City. The new building is to be nine stories high and will cost $500,000.

MIDGET Dirigible Tests Novel AIRSHIP GIRDERS

The baby airship, the Puritan, is shown above near its specially built mooring mast at the Battery, New York. At the left it is shown in flight.

BUILT as a test ship to try out new features of airship design, the baby blimp *Puritan* embodies many new ideas in construction which will be used on giant Zeppelins of the future. The *Puritan*, photographs of which are shown above, is the first dirigible constructed by the Goodyear-Zeppelin Corporation of Akron, Ohio.

Duraluminum girders with circular openings instead of the usual triangular ones are used in the *Puritan*. The new design gives great strength with extreme lightness. A vertical rudder on top of the bag, and oppositely geared propellers, give the midget airship greater stability than is usually found in craft of this type.



This photograph shows the cabin construction of the Puritan. Note the circular openings in the duraluminum girders, a new construction idea which saves weight and increases strength.

How to BUILD the "Super-Parasol"

By STEWART ROUSE

OUR flying cover artist, who is a close friend of Ed Heath's, here launches the first of a masterful series on the construction of the famous American light plane, the Heath-Henderson "Super-Parasol."

MAN IS FAST becoming air-minded, and many are experiencing a desire to own an airplane. This is a very normal situation, for the airplane entered the field of practical carriers at the close of the World War, and since that time has gained public acceptance. Contrary to popular belief, flying is not prohibitively expensive. The cost per passenger for any trip in the average five-passenger monoplane is about the same as it would be for the same trip in a large, high-grade, five-passenger automobile.

During 1924-1928 airplane manufacturers built a large number of very efficient two, three, and five-seat planes powered with motors of war-time production. The most popular types were three-seat biplanes powered with the OX-5, 90 H. P. training plane motor. These airplanes sold for about the same price as a very good automobile. The supply of new wartime motors is about exhausted now and

Complete Plans for the Fuselage

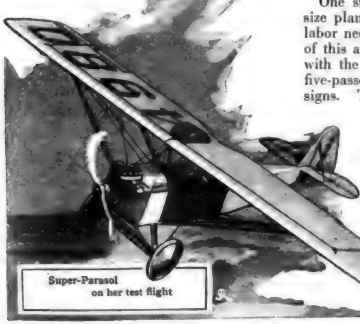
Next Month---Details of Wing and Control Construction

HEATH Sportplane

Tom Nelson, Transport Pilot and Lindy's room mate, test-flying the first "Parasol" at Chicago.

the manufacturers are powering their products with excellent new production motors, which, due to small production, and strong demand, are so expensive that the price of plane and motor together is at least double the cost with war-time motors of similar power.

This state of affairs has suddenly turned the attention of the air-minded to light one and two-passenger airplanes capable of flying with from 20 to 60 horse power. Low power motors are comparatively inexpensive due to their small size and simplicity. There are large stocks of Anzani 30 to 60 H. P. motors available at very low prices. Several makes of motorcycle motors can be converted into successful light plane motors capable of astonishing performance. A light airplane can be constructed quite inexpensively, and its cheap power plant makes the complete plane within the reach of the industrious man of average means. It is probably better to build a small airplane first, instead of a large one, for it takes much better engineering to make a large one strong; in fact, it is almost unheard-of for a light plane to prove weak. A light plane of modern design is quite safe to fly and certainly a very inexpensive traveling machine, both to produce and maintain.



Super-Parasol on her test flight

One strong objection to building a full size plane is the great number of hours of labor necessary for completion. The author of this article spent three years' spare time, with the aid of an assistant, in building a five-passenger monoplane to his own designs. This included nearly all Saturday afternoons, Sundays, and at least one night per week. It took over two thousand factory hours to build Lindbergh's "Spirit of St. Louis." An interested handy man should be able to build a successful light plane in a fraction of this time, provided he has accurate and complete plans, correct instruction and complete information. The purpose of this and the following two

New Heath Super-Parasol is Sturdy and Economical Light Plane for Stunt or Cross-Country Flying

Heath's "Tomboy" First of String

Fig. 1 of photos. This shows the first of the present day Heath string of wonderful light planes. The "Tomboy" is also shown on the title page rounding the pylon at Philadelphia in the 1926 National Air Races.

articles is to describe what is probably the most practical light plane yet built, and to present complete plans, details, and instruction for its construction.

This light airplane is the externally braced, single-seat monoplane, regularly powered with a Henderson "De Luxe" motorcycle engine, converted for airplane use, which is known as the Heath "Super-Parasol" Sportplane, after E. B. Heath, who, with Claire Linsted, designed it. E. B. Heath built his first airplane in 1908, and has operated a factory, building planes to his own designs ever since.

His first light plane which could be considered as of the modern series, of which the "Super-Parasol" monoplane is the latest, was the "Feather" built in 1918-1919, and powered with a *7 H. P. Thor Motorcycle motor!*

Considering its low horsepower this little biplane flew very well. Several other low power motors were tried in this plane with varying results. Using some of the data gained in the experiments with the "Feather," Heath designed and built in 1921-23 a biplane known as the "Favorite," powered with an OX-5, 90 H. P. motor. This plane is still one of the most efficient 90 H. P. planes in the world, and carries four large passengers with ease.

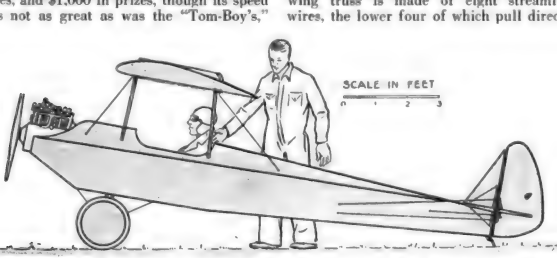
It created a sensation in 1923 by a flight with four passengers from Chicago to St. Louis, where it won all the races in its class for efficiency and speed at the 1923 National Air Races. After this triumph in low power weight carrying, Heath continued his light plane researches, and in 1925 he and Claire Linsted designed and constructed a new light plane, the "Tom-Boy" (see the title page of this article, and Fig. 1). This was a full cantilever monoplane racer (by cantilever is meant that the wings and tail had no external brace, wires or struts) with about 78 square feet of wing area; powered with a 32 H. P. Bristol "Cherub" motor, and capable of an extreme top speed of about 103 M. P. H. It won the light plane races of the 1926 National Air Races at Philadelphia with great ease, under the skilled guidance of Heath. *The prizes won totaled $2,500!*

"Baby Bullet" Data	
Span	18 ft.
Length	13 ft.
Height	4 ft.
Weight	235 lbs.
Chord	3' 6"
Wing Section	St. Cyr. 52
Area	50 sq. ft.
Landing speed	55 M. P. H.
Top speed (pilot only)	150 M. P. H.
Motor	32 H. P. Bristol Cherub
Propeller—Heath,	4' 4" diameter, 3' 6" pitch

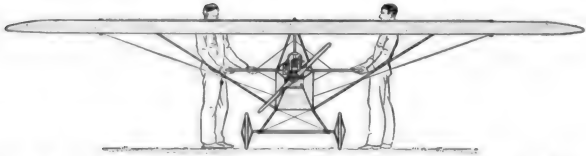
In November, 1925, the first real "Parasol" was designed and built by Ed Heath and Claire Linsted. It had a fuselage of small steel tubing, simple steel fittings and aircraft wire. The wings were a pair of Thomas-Morse Army Scout lower wings, externally braced with steel tubes and bracing cables. The "Parasol" flew strongly with a Henderson motorcycle engine, converted for airplane use. The flight testing of this light plane was done by Thomas E. Nelson, a transport pilot of the National Air Transport. He was Lindbergh's room-mate at Maywood, Illinois, before the latter's meteoric rise to fame. At that time he kept a Henderson engine, which he was converting for light plane use, under his bed. Subsequent work on conversion methods, by Heath, refined this "Heath-Henderson" motor to an efficient little aviation motor, and such motors are giving fine service as the stock motor equipment of the present "Super-Parasol."

E. B. Heath decided to make a racer for the 1927 National Air Races at Spokane. He used just a refined "Parasol" with a modern wing, and a 32 H. P. Bristol "Cherub" motor. This neat little monoplane was known as the "Spokane Super-Parasol," and won the light and sport plane races, and $1,000 in prizes, though its speed was not as great as was the "Tom-Boy's," being about 90 M. P. H. However, the "Tom Boy" is a true racer, while the "Spokane Super-Parasol" is a practical plane and *easy* to fly. Next month a picture of the "Spokane Super-Parasol," will be shown here. The "Super-Parasol" is exactly the same as the "Spokane Super-Parasol," with the two exceptions of having a slightly larger wing area, and a "Heath Henderson" 27 H. P. engine, instead of the 32 H. P. Bristol "Cherub" motor. (See next month's Modern Mechanics.)

In the spring of 1928 Heath designed and built his "Baby Bullet." This is the smallest airplane in the world, and certainly one of the fastest, as its top speed, with pilot alone, is 150 M. P. H. when opened up. (See page 62, also next part of this article in February.) Small size, a small frontal area, extremely refined streamlining, and a light, reliable motor are responsible for this tremendous speed. The fuselage is constructed of steel tubing and wire in the front half, and duralumin tubing and wire in the rear. The wings are of conventional construction excepting for the ailerons, the hinge lines of which are diagonal to the rest of the wing structure. There are no shock absorbers save the tires, and the pilot's "fanny." The wing truss is made of eight streamline wires, the lower four of which pull directly



Here she is! This shows the profile of the Heath Super-Parasol light airplane which Modern Mechanics is presenting its "how to build" fans! The men are drawn to scale so that a good comparison of relative sizes can easily be made. She's a fine ship!



Two men are here drawn to scale and foreshortened just a bit to show how the "Super-Parasol" would look from the prop end of the ship. Note the splendid visibility which the pilot has! Small frontal area, weights hung low, and good tail length make the "parasol" simple to fly.

from the centers of the hubs. The hubs are fastened together by a larger streamline wire in place of an axle.

With this racer Heath won the light and sport plane races at the 1928 National Air Races, at Los Angeles, California. The prize money amounted to $1,500. The "Baby Bullet" was unofficially timed about the five mile triangular course, at 142 M. P. H. Its official time for the fifty mile race was 112 M. P. H. carrying a weight of 75 pounds in addition to the pilot. See accompanying box for measurement data.

Parasol Easy to Fly

The "Super-Parasol," being easy to fly and economical in maintenance, is an ideal plane to use in acquiring the 200 hours flying time it is necessary to have before one can become a *transport* pilot, which is the highest air license one can get. Possessing practically every part found in a large plane, it is just as educational to build. The safety factor is about 10 to 1; that is, all parts are about 10 times as strong as necessary for level flight, making it *very safe for stunting* if carefully assembled. In cross country work it is very economical, consuming but 1 to 1½ gallons of gasoline per hour and traveling about 60 to 65 M. P. H. at cruising speed. The cockpit is roomy and can be upholstered to suit the taste. Visibility is very good, the parasol type being the best ship obtainable in this respect. The controls operate with ease, and the ship is possessed of great inherent stability. It is safe to fly in any weather that is safe for a 90 H. P., JN4 or Standard training plane.

Construction of the "Super-Parasol" should present no difficulty for the practical man. Ordinary hand wood working tools are needed, as are a few files, cold chisels, pliers, small end wrenches, hand drill, punches, heavy tin snips, soldering material, small dies, and a hack saw with *plenty* of blades! There is a small amount of brazing to be done on certain joints, which can be done cheaply in any locality. A small machinist's vise is necessary. Follow the plans with care, and remember that the structure must not only look strong, but *be* strong. Put no unnecessary scratches on any of the material for "Strength resides in the surface." If any part is in any way imperfect discard it and obtain another.

How Motor Is Converted

The back end of the Henderson "De Luxe" motor becomes the front in the airplane conversion. The flywheel cover is sawn off ahead of the flywheel, and the flywheel is removed from the crankshaft end. The crankshaft extension is riveted on the crankshaft flywheel flange, and the extension is machined integral with the crankshaft according to next month's drawings. The end of the crankcase is then faced to make a seat for the Heath-supplied cover plate. The cover plate carries a ball thrust bearing to take the propeller thrust. The propeller hub slides on to the extension and is held in place by a key and an end nut. *Closed type engine bearings are used, instead of the regular open type Henderson engine bearings.* This raises the oil pressure to 75 or 100 pounds, instead of the usual 5 or 10 pounds. Heath Airplane Company, 1727 Sedgwick St., Chicago, Ill., is probably able to do the machining better than other agencies, as they have special equipment for this job.

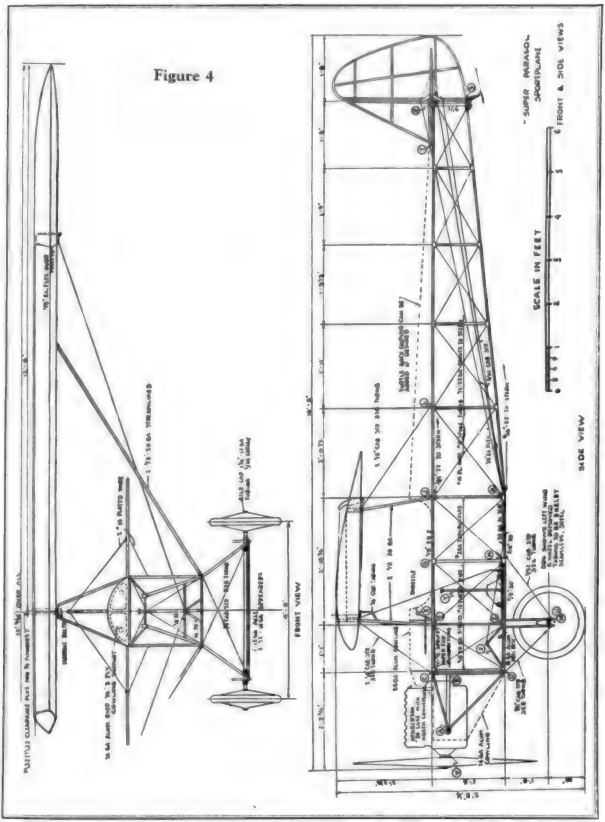
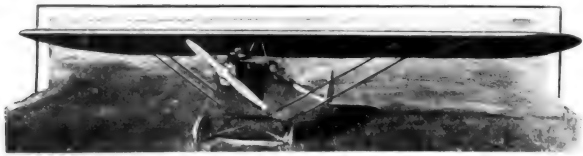


Figure 4

Details for laying out the floor jig for fuselage building are given here with all necessary notations and dimensions, together with a scale by means of which the sizes of parts not clear may be readily determined. Follow the plans carefully. Do not change a single thing!



A ship built from the plans in this series of articles, of which this is the first, snapped just as the engine died after landing. She had just put in an hour at 3,000 feet when this was taken!

The propeller is designed to utilize the 27 H. P. available to the fullest advantage and the maker's price for it is so low as to make carving it almost a waste of time.

The Fuselage

The fuselage is truly the backbone of the airplane. In the "Super-Parasol" the engine mount is the nose of the structure, as shown in the drawing on page 55. Just back of this and just beneath the monoplane wing is the pilot's cockpit. At the extreme rear of the fuselage, the tail group or empennage is attached. The landing gear is so attached that its axle is almost below the leading edge of the monoplane wing. The fuselage must be made very carefully for surprisingly great strains develop in an airplane's structure during landings. It must be durable, as it must stand years of service.

As it is impractical to show all dimensions on an airplane plan, it will be well to thoroughly acquaint oneself with the use of the draughtsman's scale. You can obtain one of these little triangular cross sectioned rulers from anyone selling drawing materials, and they or any architect or draughtsman can, in a few minutes, show you how to determine the size of any part in the plan. As these plans have been greatly reduced in size for publication, it is best to obtain a set of the large blue prints from the manufacturer, as the large drawings make scaling accurate and easy.

Floor Jig Required

The first operation is to draw, with chalk, a full size, complete, and accurate plan of one side of the fuselage (See Fig. 4-A) on a level wooden floor. Use double lines to show the struts (the vertical tubes) and the longer ones (the main tubes running fore and aft). Do not include the motor mount A C D, as this is constructed separately, being detachable; the wing supporting tubes, or the landing gear struts. Now prepare a quantity of wooden blocks about 1″ x 1″ x 2½″ and nail these in pairs one on each side of the outlines at about 18″ intervals. The purpose of this is to make the floor jig in which longerons and struts can be placed in order to have everything fit perfectly before the installation of strap fittings, bolts, rivets, wire and turnbuckles. Shelby seamless steel tubing is used throughout the structure. The longerons require a splice at J and K (see Fig. 4-B). This requires the rear tube to be slipped into the front tube about 5″, and then held by three two-penny shingle nails passed clear through both tubes and riveted. It is well to braze the end of the front tube to the wall of the rear tube. Lay the top longeron in the jig. It will require no bending for it runs straight from C to R. Next put the bottom longeron in the jig. It requires a slight bend at K. Before this bend is made, it is best to make struts DC, JK, sternpost RS, and the necessary sheet metal fittings to hold these struts in place.

With the hack saw cut off the struts about ⅛″ longer than apparently necessary. Slip a 2¼″ length of the next size smaller tube of the same gauge into the end of the strut. Heat the strut end cherry red with a blow torch or gas burner, and squeeze the last ¾″ or so flat in the vise while red. All strut and tube ends are prepared in this way. Do not flatten the ends any farther than just past the end of the sheet steel fittings, as further flattening would weaken the joint. The reenforcement is absolutely necessary (see Fig. 4-C). Flatten both ends of each strut in the same way. Then lay the struts in their correct

places in the jig. They should just fit with each end against a longeron. Correct the errors with hacksaw and file.

To make a typical 20 gauge sheet steel fitting to clamp a strut to a longeron, cut, with the tin snips, a rectangular piece large enough to encircle the longeron and then clamp flat, covering the flattened part of the strut end. Make it a little large; it can be corrected with hacksaw and tin snips. Bend it around a short piece of tube the same size as the longeron, put the free ends of the sheet steel in the vise with the tube still in place, and then squeeze flat. A neat fitting, only needing a little trimming and drilling for bolts and rivets will result (see Fig. 4-D, Fig. 3, Feb. issue).

Now install struts CD and JK with their sheet steel fittings and secure each fitting to its longeron with a rivet made of a two-penny shingle nail passed entirely through the tube and fitting. Now put the bend at K in the bottom longeron very carefully. Install the stern post. Next install all the other struts according to Fig. 1, Fig. 3.

Next in order is the installation of the hard wire and turnbuckles. This should be done with the frame lying in the jig for easy accuracy. The method of making hard wire ends is shown in Fig. 4-T. Two 1/4" bolts are secured firmly in the vise, and the wire is slipped through the space between them. Slip two ferrules on the wire before bending, one for each end. The wire is bent into an end loop as shown with the ferrule to hold the end together. Never bend any wire more than once in a place, and see that the wire has no scratches or splits, no matter how small. The shoulders should be rather sharp, and the ferrule slipped up snugly against them; finally the wire end is hooked sharply to hold the ferrule in place, and filed off. Each brace wire consists of two lengths of hard wire with a turnbuckle at the center. The wires for the front part of the fuselage, back to the strut JK, are 12 ga. plated hard wire, with No. 324 double-eyed turnbuckles. Their ends are held in the fuselage joint fittings by 3/16" machine screws passing through the sides of the fitting and the loop end of the wire. From the strut JK to the stern post, the bracing is 14 ga. plated hard wire, with No. 322 double eyed turnbuckles, with the wire ends held in the fuselage fittings with 1/8" machine screws.

Continued in February Modern Mechanics

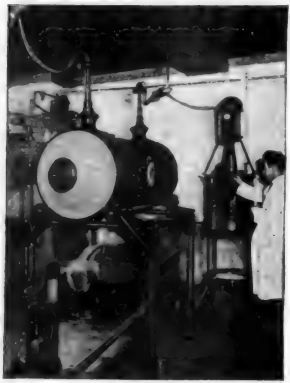
General Specifications of the "Super-Parasol" Sportplane

Span	**25 ft.**
Chord	**4 ft. 6 in.**
Angle of incidence	**3 degrees**
Wing area	**110 sq. ft.**
Aileron area	**10 sq. ft.**
Elevator area	**5.2 sq. ft.**
Stabilizer area	**5.5 sq. ft.**
Fin area	**1.0 sq. ft.**
Rudder area	**3.8 sq. ft.**
Length over all	**16 ft. 9 in.**
Height over all	**5 ft. 10 in.**
Weight, empty	**260 lbs.**
Useful load	**300 lbs.**
Gas capacity	**5 gal.**
Oil capacity	**3 qts.**
High speed	**70 m.p.h.**
Landing speed	**28 m.p.h.**
Cruising radius	**120 miles**

MOTOR SPECIFICATIONS

Type: 4-cylinder, vertical air cooled.
Horsepower: 27 at 3,000 r.p.m.
Oil Pressure 75 lbs.
Gas Consumption: 1½ gal. per hour.
Propeller: Special Heath wood propeller of 4 ft. 6 in. diameter.

250,000 Volts, Consumption of Huge X-Ray Plant



AUSTRALIA is taking the lead in cancer research with the installation in Sydney University of what is termed the most up-to-date X-ray plant in the world. The tube holder, the large cylinder shown in the central portion of the picture at the left, carries a tube capable of consuming a quarter million volts. Not satisfied with this tremendous voltage, scientists at Sydney are constructing a larger tube capable of carrying 300,000 volts.

The patient shown resting on the examination table beneath the tube, is demonstrating how the apparatus is worked. The white-frocked assistant is standing beside the control device near the wall.

SIX-FOOT MODEL BUILDING CARVED FROM WOOD

A PERFECT model of San Francisco's ferry building has been carved from wood by Fred Wilkening, a California railway motorman, shown in the picture below standing beside his six-foot model. It is accurate to the last fraction of an inch in reproducing the scale of the original building. Two years were required to complete it. The model is a masterful example of the wood carver's art, for there was much fine detail to reproduce in the window fittings and tower of the miniature structure. Especially difficult was the task of fitting tiny panes of glass in the window frames.

HUGE SEAPLANE

AN AIRPLANE designed to carry 100 passengers will be built by Edward F. Burton, aviation engineer of the Douglas airplane plant at Santa Monica, Calif. The plane will be used for transoceanic and coastwise passenger service. The inventor calls it a sesquiseaplane. He is shown above with a five-foot model of his ship. The airplane will have a wing spread of 150 feet and will be powered with eight 525 horse-power motors. Its cruising range will be 3,000 miles.

Insects Drown in a Household Gnat-Destroyer

MOSQUITOES, moths, gnats, and other small insects are destroyed by the latest article of household furniture shown in the photograph. The inventor calls it a Gnat Destroyer. It is simple in operation, consisting of an electric light, a fan, and a basin of water encased in a mahogany cabinet. Any insects which may be in the room are attracted by the brilliant light. When they fly within range, a rapidly revolving fan sucks them through a funnel and blows them into a pan of water, where they drown.

—Keystone.

1000 HORSEPOWER MOTOR BUILT

A new Rolls-Royce motor which is expected to propel an airplane at the rate of 360 miles an hour has recently been tested. It is rated at 490 horsepower, but can develop 1000 horsepower when properly tuned for racing. The engine weighs only 865 pounds, or less than one pound per horsepower.

EMERGENCY BULB HOLDER

IT is annoying to have one of the light bulbs in the basement, store cellar, or garage "blink" out just when you need it, and it isn't much fun to grope around after another one in the dark. Why not have an extra light bulb in a handy place? Procure several old springs from an auto seat. Throw them in the fire, heat until red hot and let them cool slowly. This takes the temper out of them. Straighten out the small ends and bend into a U shape as shown in the picture. Nail them up out of the way but in conveniently reached places. Drop in a good bulb and you will be ready for the next one which "goes bad" on the job.

PERFORATED STRIPS ELIMINATE SOLDERING

A NEW system of wiring up radio sets has been devised by a London engineer who conceived the idea of using perforated metal strips instead of wire. The strips can be bent and joined together at will, eliminating the need for soldering the joints. The photograph shows the strips being used in wiring up a home-made set.

Aluminum Man Startles London

He talks, walks, stands, sits down, rolls his eyes and waves his hands, but he isn't a man at all — nothing but a mechanism of steel and aluminum, cables and gears and electric motors! His life-like actions astonished London at a recent scientific exhibition.

Eric, the talking Robot, is shown above making an oration. Sparks flash from his mouth when he speaks.

ALL LONDON recently flocked to see "Eric," the talking mechanical man who opened the popular scientific exhibition organized by the British *Model Engineer*. With an anatomy composed mainly of steel rods and bars, and a stylish suiting of sheet aluminum, he is an ideal representative of the race of Robots who at some future date are to dominate the world. At least, we have been told so in a very successful play, and many people are seriously looking forward to the time when much of the toilsome labor will be performed by mechanical workers.

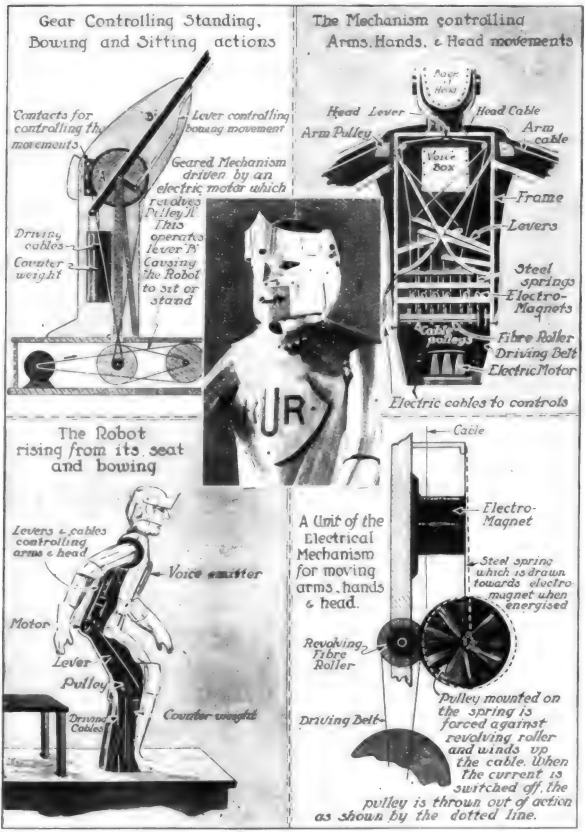
"Eric" weighs a little over 100 pounds; he will get up and bow at the word of command, he will make a speech, he will answer questions, he will move his arms, and head to give point to his remarks, and when told to sit down, he obeys at once without a protest. He is very docile, but his eyes flash while he is speaking, and crackling sparks at his mouth give brilliance to his oratory.

He is actuated by 12-volt electric motors, supplied with current from a battery. There are wheels, belts, levers, and joints, all ingeniously geared up to give the required movements. His speech is the voice of his master, or of his master's man, but how it gets to "Eric's" lips is one of the mysteries which W. H. Richards and A. H. Reffell, the joint inventors, are not yet prepared to disclose.

His powers in this direction have been turned to good account, for he has earned the distinction of being the first mechanical man to open an exhibition. At the appointed hour on the opening day, he solemnly rose and bowed to a gathering of some thousands of eager folk drawn thither by the remarkable rumours which had run like wildfire round London during the previous week. Unabashed by the tumultuous applause which greeted him on rising, he delivered a most eloquent oration, descriptive of the purpose of the Exhibition, and then formally declared it open to the public.

Many prophecies have been made as to "Eric's" future. He is not yet prepared to scrub floors, or do the domestic washing and ironing, nor can he operate a handcrane or a lathe. But he would make an excellent salesman in a department store, telling the virtues of the bargains there displayed. At present he is merely a clever combination of well-known mechanical and electrical devices arranged and dressed to grip the popular imagination.

How the Mechanical Man Walks and Talks



The arrangement of levers, gears and weights by which the mechanical man produces his life-like gestures is shown in the above diagrams. The Robot was built in six months.

BIRD-SIZE *Plane Wins*

STREAKING low above the ground, a tiny silver plane whines toward the pylon at the National Air Races held at Los Angeles. With speed which seems more comparable to that of a projectile than an airplane she bursts from nowhere and is gone with a whine. It is Ed Heath's "Baby Bullet," smaller than a South American Condor!

A stooping man's shoulders come just even with the wings!

by RAOUL WHITFIELD

OUT at Mines Field, Los Angeles, California, there were perhaps a hundred planes of all types along the deadline during the National Air Races. I walked around behind a big bomber, stumbled over the tail assembly of a ship—and fell into the cockpit. Can't be done, you think? Well, you don't know the *Baby Bullet.* It was her tail assembly I stumbled over—and her cockpit I fell into. I didn't fall all the way in—you've got to *squeeze* in. Looking around for her pilot—I was

A Plane Smaller Than a Condor!

The Baby Bullet is a plane smaller than a bird! The South American Condor often attains wing spreads of nineteen and twenty feet, and the Albatross as high as twenty-two feet. The Baby Bullet with a wing spread of eighteen feet, will take you 100 miles in 40 minutes.

AIR RACE at 140 m. p. h.!

thinking of apologies—I watched a rather short individual calmly walk up, lift the tail assembly, and start to pull the plane along after him. He sort of strolled along with her. She certainly is a convenient crate to have around.

The plane has a wing spread of but eighteen feet; she's only thirteen feet from propeller tip to the trailing edge of her rudder fin. She's a monoplane, and with her two-cylinder engine can develop a speed of one hundred and fifty miles an hour. I neglected to get her weight, but it isn't much.

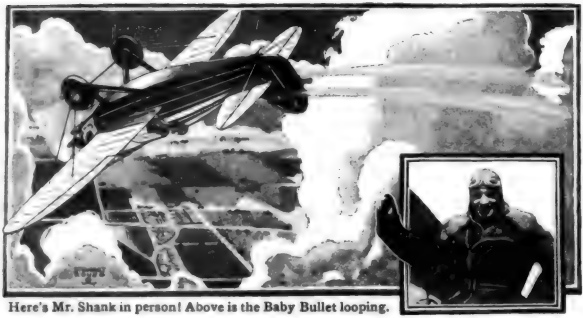
The tiny plane was designed, built and flown by E. J. Heath, of Chicago. She's the sort of a crate you can easily keep in a garage—a two-car garage—by knocking out the wood between the two doors. She looks like a trim ship—and she is. She won the Fifty Mile Free-For-All small engine race at the field. And she did it throttled down. Beat five other planes.

The photo on page 62 shows the baby ship about thirty seconds before the start of the race around the five-mile course. Her pilot is in the cockpit—even if you can't see him—and her prop is whirling. She's in the number one position, the first to be waved off. Note that her wing surfaces barely reach the average man's knees. The kneeling gentleman is about to kick the board used as a wheel chuck out of the way.

The checkered flag dropped, and this crate got off. In a hurry. Her pilot didn't hold her on the ground long. He didn't have to do that. She was almost lost from sight, because of her size, getting around the first pylon turn. She made the first two or three laps on the triangular course at about one hundred and forty miles an hour. But she was catching up on the other ships so fast that her pilot throttled down. He didn't want to lap them.

She came down in a nice landing, after the finish. Her pilot picked up the tail assembly and trundled her over to the deadline. First prize was two thousand, five hundred dollars—and he was grinning. He'd probably used a couple of quarts of gas and a pint of oil in copping the prize. The little crate is rightly named—she's a baby bullet. It's a real thrill, watching this tiniest of airplanes do its stuff.

Because of the camera's well known tendency to enlarge things near at hand, this photo does not do justice to the "Babe." She looks here much larger than she really is. Amelia Earhart is shown standing on the off side of the diminutive cockpit, which comes barely to her waist!



Here's Mr. Shank in person! Above is the Baby Bullet looping.

A Lesson in Advanced Flying

By PILOT GENE SHANK

PILOT SHANK'S last two articles appeared in November and December issues. In them Gene told the hangar gang how to take a "sky buggy" up and get her back safely, as well as about the elements of piloting. Here we start with a stunt and a few of the tricks of test flying!

GATHER round, all you hangar hounds! I'm goin' to tell you that after you have soloed—taken the old wagon into the sky, made a few turns and sharp banks and all that sort of thing—that then is just the time you don't know *anything* about flying! It is the time that overconfidence develops, and so that you don't go at this flying game in chunks larger than you can bite off, I'm only goin' to tell you a few things that might be termed near-beer elements of the art of shagging a crate around the cottony blue. All you're goin' to get this time is a bald statement of what a loop is all about, how to do it, and how to test fly—safely and sanely—your own Heath Parasol.

Here's the low down: loops aren't so very much different from straightaway flying. You don't have the sensation of scurrying around inside the barrel, like it looks to the man on the ground.

All it seems to be is a slight increase of pressure on the seat. Then the sky in front of the plane turns light blue, anyway, you go right up, lookin' at nothin'. All of a sudden you seem to quit climbing and for the shady side of a second you feel as though you were stopped dead still, going somewhere, but hanging in space. Then the sky darkens, the old sod below seems to be rolling from in front of the ship right down under it as fast as it can go places, and then the flying wires begin to scream, the pressure on your seat increases again, and you level off. You have looped the loop!

To execute a good loop, you first must have a reliable ship, and especially you light plane bugs. Be sure the carburetor won't load up, and that you have a loop or two in the gas line outside the old aspirator, or she'll run out of gas, maybe, sputter—and well, that's why a few pilots never come home. Lightplanes as a whole are far stronger structurally than they have

Instructions for Looping the Loop and Test Flying Your Airplane

need of being. It is the motor which must be reliable.

The second requirement is a good bit of altitude. The loop is started by a slight dive to gain speed. Throttle the motor so that it does not speed up as you are diving. Point your mark along the ship which you usually tally with the horizon for an even flight so that it is considerably below the horizon. Just about the time the flying wires whistle, pull back firmly on the stick and give the mill up front all she has in her, wide out!

Here's where the first act of coordination must come in. As you sense the ship beginning to fall over on her back as it will seem, cut the throttle! The momentum and the rapidly building up force of gravity will soon have her kiting for earth, and here's where you pull the stick back right into your lap ever so gently, for a hard yank will bring her up too suddenly with the attendant risk of giving the wings too much of a bite and breakin' 'em off. And that's not funny, because you can't get out and walk back to fix 'em.

Give her the gun again as she levels off, and kite along. But while you are doing all this, bear in mind you want to keep straight rudder and aileron, because if you mix any of those two you won't have a loop. You'll have a panic.

Now a word about test flying. Of course the word test flying implies that the ship shall be put into the hands of a super pilot who not only can fly rings around a Zulu's grass skirt, but can tell after it's all over what happened, and just why it happened, at the same time recommending changes.

Lightplanes, however, if they are built in accordance with the details furnished in the complete plans which Modern Mechanics will run from month to month as a series, will be structurally above any licking you can give her in the air if she is built as shown in the plans.

Take the pine and wire Pegasus up till she won't climb any more. Then in sailor's parlance, you've got water to navigate in, only in our case it's air—and air is the safest thing for an airplane to be in—don't forget it!

Then just merely practice a few "landings" at about 3,000 feet, getting the feel of how she settles, what her response is to crabbing the rudder, and how she jumps around in answering the ailerons. Play until you know how she acts and until you have accustomed yourself to her idiosyncrasies (I ought to get a whole nickel for that word) and you are ready to take her down into the tarmac.

Here's a German-built light airplane which weighs less than 500 pounds complete. The wings are level with the average man's shoulders. Instructions for building planes of this type will appear in Modern Mechanics' great "How-to-build" series on light airplane design.

Making Your Money

When madame deposits a sheaf of old, worn-out paper currency at her bank, it is entirely possible that it will come back to her a few months later in the form of stationery. Old bills are sent to the Treasury at Washington for redemption, where they are handled in bales like waste paper.

USING newly perfected methods of paper manufacture, Uncle Sam has increased the life-span of the average dollar bill fully three times! This article takes you behind the scenes of the world's greatest money factory.

INCREASING the life of the dollar bill is the latest achievement of the U. S. Treasury, a feat which has involved several years of research and which has resulted in the perfection of grease-proof, oil-resistant, wear-worthy currency which will last longer than any ever previously produced.

The advent and popularization of the automobile, strange to say, increased the wear and tear to which dollar bills were exposed so that their life was shortened one-half. The remarkable prosperity of these United States has also increased the ordinary use of paper currency. Before the automobile, our one dollar greenbacks and silver currency were serviceable for 12 months' use. The full moon of the motor age cut this life cycle in half.

Motorists carry much more cash than our former buggy and coach-users. Their wallets are filled with emergency paper money for paying for gas, oil, auto repairs and traffic fines. The money used by the motorists and service stations is exposed to grease, grime, oily hands and dirty pockets. Grease is one of the particular foes of paper currency.

New Money for Old

Matters went from bad to worse. The point was reached where Uncle Sam had to replace 1,200 tons of old money with new annually, a total of about $4,000,000,000. The facilities of the Bureau of Engraving and Printing were taxed to capacity. National money makers worked night and day striving to keep ahead of paper currency needs.

Uncle Sam assigned to his reliable research scientists the task of determining how best to armor and reinforce paper money so that its period in circulation might be increased one or two months or more. The paper experts began at the very beginning by checking up on the methods of manufacture employed in making the safety paper

Last LONGER

By WILL BRADFORD

Redeemed currency is deposited in digesters which reduce the bills to paper pulp. It is then a simple process to run the pulp through paper making machines, and thus a twenty-dollar bill, worn out in service, is reduced to boxboard, letterheads or scented stationery.

used in currency production. They devised machines to test the wearing qualities of currency. A dollar bill folding device was invented, which subjected dollar bills to foldings and creasings such as they would suffer in your pocketbook, or mine. The average dollar bill wore through when subjected to 2,000 such foldings.

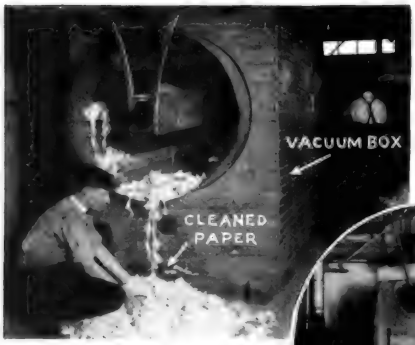
The paper used for currency is made of a mixture of three parts cotton and one part linen rags of the best quality. Thorough tests brought to light the fact that this paper was exposed to too much "beating" in the production process so that its fibers were weakened. By decreasing this "beating," a better paper was produced which would withstand 6,000 test foldings. This scientific investigation resulted in the output of a safety paper three times as strong as that used originally.

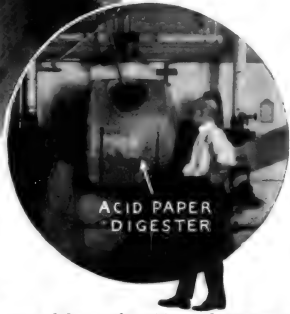
Protected From Grease

A great variety of chemicals were then tested for the treatment of the safety paper so that it would be better qualified to withstand the damaging effects of greasy hands and oily pockets, wallets and cash registers. A certain formaldehyde solution was finally developed which when sprayed over the paper currency protected it against grease and grime.

Tests were also made of the tensile strength, bursting strength, tear-ability, thickness, opacity and inking qualities of the new safety paper to see that it was satisfactory. A number of test batches of the paper were made in the miniature Government paper mill. Eventually, paper currency of the smaller denominations was made and circulated in test amounts. It demonstrated conclusively that it was 50 per cent stronger and longer-wearing than the paper money formerly used. Its current use

A special detail of police surrounds the trucks which transport freshly printed currency from the Government Printing Plant for shipment to banks throughout the country.





At the left is shown a machine which cuts redeemed paper currency into ribbons. A whirling fan removes all dust and dirt. Below is an acid digester which removes all ink from the bills so that they are not recognizable as currency. Both of these machines are in the Treasury Department at Washington.

has decreased the strain on Uncle Sam's paper money plant at Washington.

The scientists delegated to experiment with the unsatisfactory paper money also discovered more profitable uses for redeemed currency. Some 40 carloads, equivalent to 1,450 tons of worn out paper money, are returned to the Treasury annually from all parts of the United States. Uncle Sam exchanges new money for old, replacing each dilapitated, ragged dollar bill with a crackling, spotless greenback of similar denomination.

Greenbacks for Souvenirs!

Redeemed currency is dumped into a battery of 10 macerators which chew it into mincemeat form. The macerated money is then converted into paper pulp and sold commercially for the manufacture of coarse cardboard, fibre board, shoe counters and similar materials. Souvenirs such as statuettes of the Washington Monument are also made from money mincemeat and sold to tourists. The money is de-inked and mutilated so completely that it cannot be used for illegal purposes. For many years the Government has lost money on its paper currency redemption.

The investigators found that by dusting and cleaning the macerated money more carefully, they could produce a paper pulp of better quality suitable for the manufacture of fine grade writing and printing paper. Milady now uses monogrammed stationery made from worn out greenbacks and yellowbacks. The paper money which you spend thus may come home again in a new and revised form so that you don't recognize it. The U. S. Government will henceforth realize a good net profit from paper currency redemption.

The last and most important step in the improvement of our paper money results from the Treasury Department's decision to reduce the size of our dollar bills to smaller dimensions. Our present paper currency is of standard 7 $\frac{3}{16}$ by 3$\frac{1}{8}$ inches dimensions. The new dollar bills, to be circulated first in 1929, will be one-third smaller, with dimenions of 6$\frac{1}{8}$ by 2$\frac{5}{8}$ inches.

Cutting the size of our most popular denominations of paper money will result in enormous savings in ink and paper, and will increase

the storage space in the U. S. treasury and federal reserve banks one-third. The new bills will be easier to handle, much more durable and more difficult to counterfeit successfully. The same cash registers and money counting machines now in use can be employed efficiently in handling the new size silver certificates. Later, greenbacks of the other popular denominations will also be made in reduced dimensions. It will take five years to replace the old paper currency with new.

Money Factory Remodeled

The jump from the manufacture of one size of money to another has necessitated vital equipment changes at the Government's paper money factory. Old presses have required complete remodelling and new presses have been built on special contracts. Copper plates of the new silver certificates have been made by the national engravers, the most skilled craftsmen of their trade in the world. This task in itself is colossal, for it takes seven engravers 4½ months to produce one of these valuable money plates. Many different engravers work on each plate to contribute individual touches and to increase the difficulties of counterfeiting such plates.

The new pesos size one dollar bills will bear the likeness of George Washington on their faces. This picture is one of the finest pieces of plate printing ever performed. It is wholly impossible to counterfeit this silver certificate so that Government specialists cannot detect the fraud. If you will examine one of these new dollar bills carefully, you will notice how the picture of Washington stands out and looks as though that distinguished soldier and statesman was going to step from the paper to greet you. All photographic attempts to counterfeit that picture have failed because the reproductions invariably appear flat and are easy to detect. The future small size two dollar bills will bear the photograph of Thomas Jefferson, the fives will carry the likeness of Abraham Lincoln, while the tens will reproduce the features of Theodore Roosevelt.

Uncle Sam's present paper currency system is the most complicated in the world for it consists of five national currencies and 39 different types of paper money. Only financial experts, bankers and money specialists can readily identify all varieties on sight. The average layman knows the bills

This man is performing the delicate operation of engraving a steel plate from which currency will be printed. Each engraver is a specialist within his own line; some men are experts at engraving faces, others are better at reproducing lathework patterns. The plate for a single bill goes through many hands before it is completed.

How a Corner of Uncle Sam's Money Factory Looks to the Camera

These women are sorting newly printed currency in the Bureau of Engraving and Printing at Washington. Millions of dollars are represented in the stacks shown in this picture.

only by the figures indicating their purchasing power. To unscramble this paper money puzzle is another purpose of Uncle Sam in the reforms which he will institute.

Originally we had available five different varieties of one dollar bills. Under the new plan, we will have available for spending purposes only one style of one dollar bill, the silver certificate. The $2 and $5 bills will be similarly standardized when produced in reduced sizes. Our 39 money varieties will be reduced ultimately to 11.

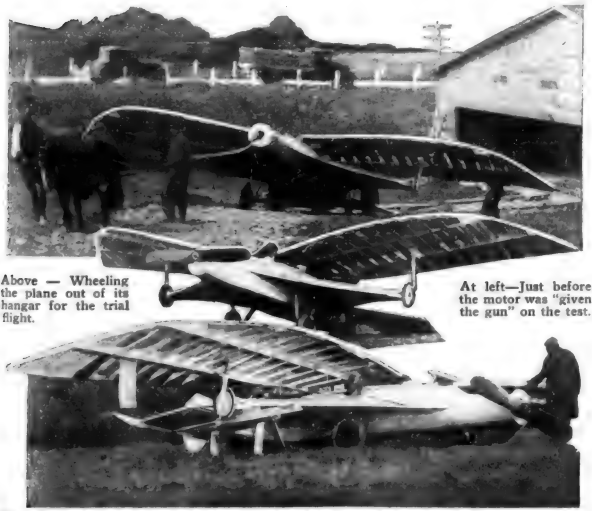
TALKING MOVIES BROADCAST POLITICAL SPEECHES

BRITISH politicians have seized on the talking movie as a novel means of waging their campaigns in the general elections soon to come before the public. The photograph shows a London crowd listening to an open-air movie speech on a street-corner. These exhibitions, of course, are free to the public, and the novel method always succeeds in attracting an audience. Politicians prefer this system to talking on a soap box, since it not only prevents them from being annoyed by hecklers, but also permits them to be in a number of places at the same time.

Each political party has its own "talkies" located at strategic spots. The one in the picture, as may be told by the sign, has been established by the Conservative party.

"Mystery Plane" flaps Self to Pieces in Trial Flight

Built with flapping wings and bird-like body, this "American Eagle" plane collapsed before its inventor could get the novel machine off the ground!



Above — Wheeling the plane out of its hangar for the trial flight.

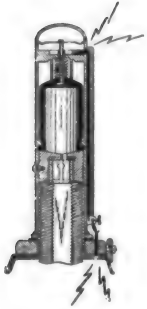
At left—Just before the motor was "given the gun" on the test.

Shown above is all that was left of the novel bird-plane after it had shaken itself to pieces. The inventor expects to rebuild it, using stronger metal throughout to strengthen its construction.

THE mystery attached to the so-called "mystery airplane" built by James A. Crane of Ellsworth, Maine, seems to be—"Why doesn't it fly?" Built with flapping wings designed to lift it straight up into the air, the strange plane collapsed a few minutes after its motor was started up. The inventor, however, was undaunted. He expects to rebuild his plane, which he calls the "American Eagle," substituting metal wings for the wooden ones which the first test proved to be too flimsy. The cranking arrangement by which the wings were flapped is clearly shown in the above photographs.

PATENTS ~ NUTTY or NOVEL?

HERE are a few more recently patented "dream kites" which the inventors who planned them hope will soar to dizzy heights of fame and fortune. Just how useful they will prove to be only time can tell.

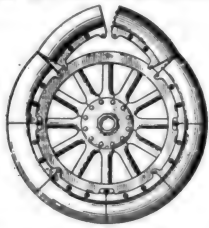


Which Are They—Nutty or Novel?

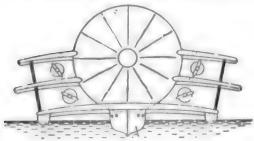
TOOT! TOOT! YER TIRE'S FLAT!

Instead of clumping along for miles swearing at the rough roads when you really are ruining a good tire that has gone flat, an Idaho inventor proposes you should use his ingeniously devised gadget which screws on over the tire valve in place of the regular valve cap. When the air in your tire escapes its rubber jail as you go humming along on a dark night, you will, if you have installed this signal, be warned of the fact by a loud electrically operated horn placed on the dashboard!

RIP 'ER OFF IN SECTIONS!



IS THIS HENRY'S HUNCH?



No less an authority than Henry Ford declares that the airship of the future will be a combination of all the mechanical grapefruit and rhubarb known to aerial invention. Such a ship as Henry visualizes is shown here, with a central gas bag, airplane wings, ship hull and undisclosed helicopter propellers. To all these proposals, Dr. Hugo Eckener, who also knows something about airships, being designer of the Graf Zeppelin, voices the German equivalent of the word "Hooey!"

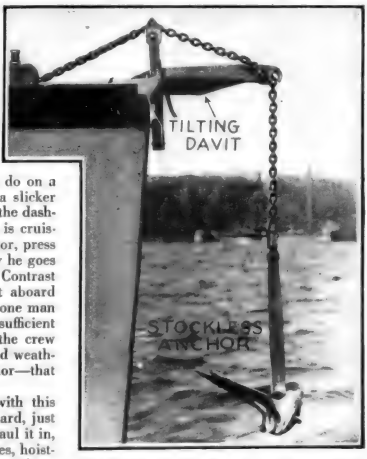
Possibly, in conjunction with the flat tire signal above, you will be strictly up to date and will be using this type of tire when the electric call comes for a change. Instead of wrangling a whole casing off the rim, all you will have to do is run the car ahead a few inches until the deflated section of this ultra modern tire is uppermost. Then you will quickly be able to effect a change of tire with a fresh segment—theoretically. But how about all the friction between "the pieces of pie?" And think of all the signals you'd need!

This Electric Winch Hoists and Stows An Anchor

A NEW electric anchor has been invented that means one-man control in operating a cruiser or yacht. There is a decided advantage in having instant control of the anchor without going forward or even leaving the wheel. This anchor is controlled by a little electric push button installed in the deck house or beside the steering wheel.

All that Mr. Yacht Owner has to do on a stormy night these days, is to slip a slicker on over his pajamas, hie himself to the dashboard of the high powered boat he is cruising on, press a button to weigh anchor, press another to start his motor, and away he goes to a more sheltered anchorage. Contrast this with the days when men slept aboard their yachts half clothed and with one man constantly on watch so as to give sufficient warning of the weather to enable the crew to tumble to and make ready for bad weather—and as for hoisting the anchor—that took beef!

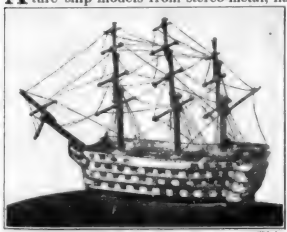
Today it is different. Today, with this device, in putting the anchor overboard, just press a button. Over it goes. To haul it in, press the same button and up it comes, hoisted on deck and locked securely in place. Such an anchor is sturdily built and easily installed on any cruiser or yacht up to 80 feet in length.



An electric windlass hoists the anchor from the bottom. A special tilting davit clasps the flukes of the "hook" and as the chain reels in, stows it neatly on deck.

SHIP MODEL CARVED FROM TYPE METAL

AN INGENIOUS method of making miniature ship models from stereo-metal, has been devised by Mr. A. Pepe, a London process engraver. His interest having been aroused by seeing some of the old model ships made in bone by French prisoners of war in England in the early days of the last century, he thought he would try his hand on some models in a different material. Looking around his engraving establishment, he took up a small block of stereo-metal, and began to carve it into shape. Stereo-metal is very much like lead in weight and appearance, but is a little harder, and closer in texture. He went on cutting and carving and eventually produced the hull of a pretty little model of Nelson's famous "Victory." The masts and spars were very simply made, carpenter's wire nails furnishing the materials ready to hand.



Here's a sweet job of carving for you. This two-inch ship model was carved from type-metal with a jacknife by a London process engraver.

Shackleton the Pioneer

by W. H. TURNER
Technical Editor Encyclopedia Brittanica

TWENTY years ago Shackleton set out for Antarctica with a shipload of equipment. Today a million dollar expedition with four ships and four airplanes is exploring the same ground—but in what a different way! Old and new methods of exploration are graphically contrasted in this authoritative article.

WHEN Sir Ernest Shackleton organized his famous South Pole Expedition in 1907, he carried all of his equipment on one ship, the *Endurance*. Men, dog teams, provisions, instruments—everything had to be carried on the one frail barkentine and when the *Endurance* was caught in the ice floes and slowly crushed to kindling in one of the most dramatic episodes in the history of polar exploration, the hardy adventurers were forced to take to the drifting ice and undergo incredible hardships before they finally reached Elephant Island. Then Shackleton, with five companions, set out on a perilous 800 mile voyage to South Georgia in a whaleboat—crossed the bleak mountains a foot to a settlement, where a relief expedition was organized to rescue the marooned men.

Contrast this story of privation with the epic of the Byrd expedition, now under way. Byrd is using four ships, four airplanes, is carrying 75 dogs, a crew of polar scientists and adventurers totaling 75 in number, a complete Antarctic village with specially constructed houses, workshops, airplane hangars, tractors, and hundreds of pieces of delicate apparatus. Shackleton spent dreary winter nights in complete darkness, with little protection from blizzards and terrific winds—just as the present-day Viking would be forced to do if he did not avail himself of modern equipment.

Life on shipboard and on the ice in the Antarctic regions can be made just as com-

Ice caught Shackleton's ship Endurance in its remorseless clutch and crushed it to kindling. The photograph shows the ship lodged tight in the ice floe, and gives an excellent idea of bleak wastes of ice which stretch everywhere as far as the eye can reach. In the foreground a member of the Shackleton expedition is foraging for food.

vs. BYRD *the Scientist*

Here is a remarkable night photo of Shackleton's Endurance being crushed to death by the ice pack. The photograph was taken by the aid of flaring oil fires, which outlined the doomed ship against the background of the long Antarctic night. Note the huge ice cakes.

fortable as if civilization were just around the corner, rather than thousands of miles away.

To understand the sheer daring of those steel hearted pioneers who first staked their all in reaching the South Pole, it must be realized that the Antarctic continent is as large as the United States and Canada combined.

Imagine Canada and the United States covered with ice and snow. A thousand miles in the uninhabited interior, near Chicago, lies a place called the South Pole. A few men—with Scott and Amundsen—have walked and struggled on foot through blizzards and gales, often falling into crevasses, from this New York to Chicago. But to say that these men walked this distance with sledges is not enough. This mythical Chicago lies on a plateau nearly 10,000 feet high.

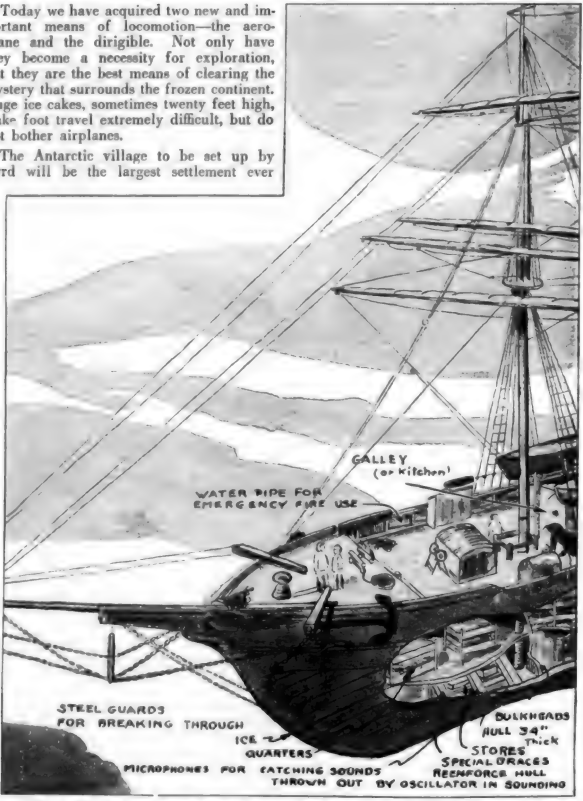
Toiling up mountains, from the sides of which creep the mightiest glaciers on earth, was an additional undertaking calling for tremendous exertion. Further imagine Canada and the United States surrounded by a belt of impenetrable ice. Very little of the coast line is known. New York harbor has been discovered and a few islands off the coast on all sides. This, in a measure, represents the circumstances that the Antarctic pioneer must prepare to face.

Heretofore there have been three chief means of locomotion for the exploration of the polar regions: Sailing in a ship, sledge traveling with or without dogs, and drift with the ice. The use of the first method is limited by the impenetrable ice preventing the movement of the ship.

Byrd's Base Ship "City of New York" Provides All the Comforts and

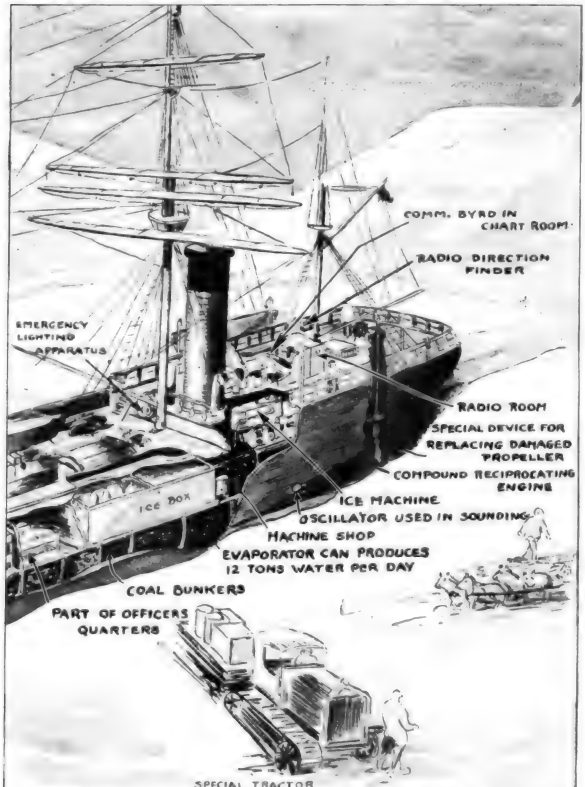
Today we have acquired two new and important means of locomotion—the aeroplane and the dirigible. Not only have they become a necessity for exploration, but they are the best means of clearing the mystery that surrounds the frozen continent. Huge ice cakes, sometimes twenty feet high, make foot travel extremely difficult, but do not bother airplanes.

The Antarctic village to be set up by Byrd will be the largest settlement ever



This drawing of Byrd's ship, the "City of New York," shows the arrangements for providing comfortable quarters for men and officers. This boat will be the base ship of the Expedition.

Conveniences of Home for His Crew of South Pole Explorers



An unusual well through the ship over the propeller makes it possible to repair a damaged blade without delay. A two-ton cap at the bottom of the well prevents water from surging through.

Orange Houses Make Base Camp Easily Sighted from Planes

raised in an expedition in the southern seas. It will consist of five main buildings and a number of provision caches and instrument houses.

The walls of the building will be four inches thick and will be painted orange so that they can be seen from the airplane at a great distance. On the outside is a stiff building board one-half an inch thick. Next come two layers of building paper, a layer of building board, one and one-half inches of kapok insulation, a layer of fibre insulation, more kapok, and a final layer of building board.

Beams supporting the building and tying it together are held by bolts which do not go to the outside, so that they will not transmit cold.

The largest and most important building will be the executive headquarters, which will house the radio apparatus, the scientists, the doctor's quarters, Commander Byrd's own quarters and an office. In a part of this room will be complete photographic apparatus so that pictures taken during flights can be immediately developed as an aid to mapping the country traversed. In another wing will be the radio rooms, where the short and long wave apparatus and the direction finder for use in keeping track of the plane during flights will be installed.

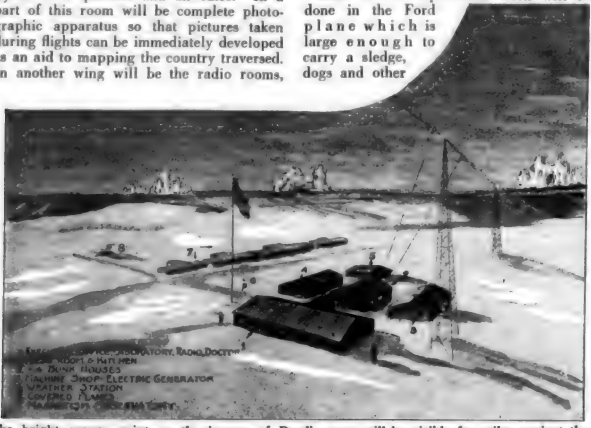
Joining the executive building is to be the mess hall and kitchen. It will contain a piano, and this hall will probably be used to show motion pictures of the expedition long before they are shown in America.

Four Planes Carried

On either side of the mess hall, and close to it so that communication may be maintained by tunnels through the snow, will be the bunk houses. The machine shop will be stocked with all machinery necessary for making repairs to airplanes, tractors, motors, etc. Heating will be by oil stoves.

Four airplanes are carried, a Ford plane, the *Floyd Bennett;* a Fokker, the *Stars and Stripes;* a Fairchild, the *Virginia;* and a General Airplane Corporation plane.

Most of the exploration work will be done in the Ford plane which is large enough to carry a sledge, dogs and other



The bright orange paint on the houses of Byrd's camp will be visible for miles against the snow. This is the camp you will be in touch with if you watch for the set Charles Magee Adams will tell you how to build in order to tune in on the short wave sending from the expedition's transmitting set. See Radio Dept. for details.

Shackleton, the gallant commander, is the first man on the left in the upper picture, which shows members of the expedition camping on an ice floe after their ship had gone down. Shackleton is also shown at the right in the lower picture, seated alongside an Arctic stove outside the tent in which he lived for months.

emergency equipment. The smaller planes will be used for scouting and mapping.

The pole lies 800 miles from the proposed site of the base and this will mean a non-stop flight of 1,600 miles when the dash is attempted.

Such a trek on foot was almost certain death after weeks of exhaustive travel. With modern equipment, it is a matter of a few hours in relative safety.

A half million cigarettes are carried, along with a ton of tobacco and a barrel of pipes. A made to order, ultraviolet ray, will be available. This device will be of tremendous importance as a substitute for sunlight during the long night. It is a lamp similar to that seen in many city homes, consisting of a vacuum tube of pure quartz, in which mercury is turned to vapor by an electric current.

The million dollar expedition has two ships that will stay in the vicinity of the South Pole two or three years. The *City of New York* will serve as the base-ship within the ice barrier. The *Eleanor Boling* will remain outside the ice barrier and act as a relief vessel.

Two other ships will transport supplies and equipment to the nearest civilization, a thousand miles away in New Zealand.

This vast expedition can live and carry on its work without contact with the world for as long a time as will be necessary for the attainment of their scientific ends. Shackleton, Scott, and Amundsen, and other pioneers could exist for only a few months without relief from the world beyond the ice barrier, and their data gathering facilities were extremely limited. The modern explorer collects and studies the results at his base.

Chicago Football Star Wears Glasses in Helmet

This football player wears spectacles in his headgear.

WHEN BENNY WATTENBERG, star half back of the University of Chicago football squad, discovered that he was hampered in executing forward passes because of near-sightedness, the coaches decided that Wattenberg was too good a man to lose and they devised a method of fastening special shatter-proof lenses to his football gear. The photograph shows the half back wearing his helmet with the spectacles that have corrected his defect of vision.

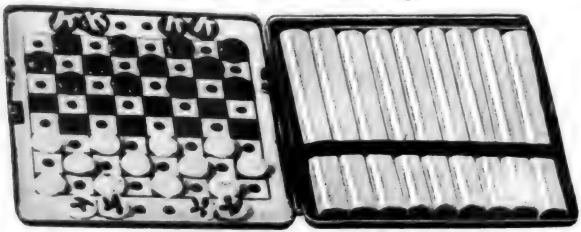
UNIQUE USES FOR AIRPLANES

THE ONLY commercial plane equipped with charcoal foot-warmers is said to be the ski-shod "Queen of the Yukon," which makes a daily flight of 560 miles from Whitehorse to Dawson, Alaska. The plane is a passenger and mail carrier operated by a private company which issues its own air mail stamps. The "Queen of the Yukon" has flown 100,000 miles.

One of the largest sheep raising firms in Australia uses an airplane for inspection work and for transporting company officials across the tremendous ranges. The plane used is a Mahoney ship, built by the makers of the "Spirit of St. Louis." An airplane of the same type was recently delivered to two Italian noblemen who plan to conduct daily sightseeing trips from the banks of the Tiber River.

CHECKERBOARD COMBINED WITH CIGARETTE CASE

THE NOVEL cigarette case shown below contains not only smoking materials, but also a complete checkerboard and men. The white and black pieces are small pegs which fit into holes in the squares to prevent them from being lost.



Five-Story Steel Ball Makes Novel Hospital

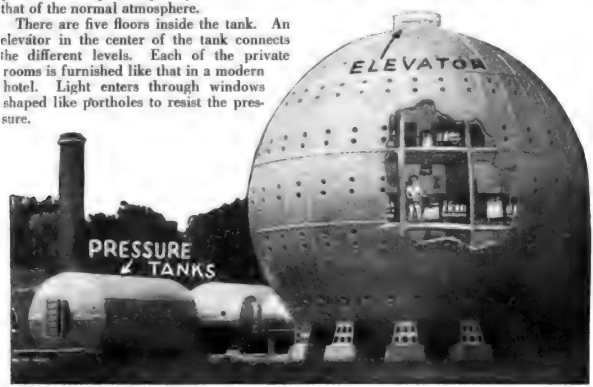
RESEMBLING a strange machine from another planet, a huge steel ball standing five stories high is being erected at Cleveland, Ohio, so that persons suffering from diabetes may be given treatment under ideal conditions.

In the strange spherical "health hotel," patients will live constantly in an atmosphere of high oxygen content, maintained at a pressure of 30 pounds per square inch, twice that of the normal atmosphere.

There are five floors inside the tank. An elevator in the center of the tank connects the different levels. Each of the private rooms is furnished like that in a modern hotel. Light enters through windows shaped like portholes to resist the pressure.

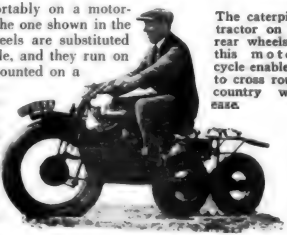
The treatment tank was designed in the shape of a ball so that air-tight seams could be secured more easily.

Air under 30 pounds pressure will be maintained, and the temperature and humidity will be carefully regulated. A large refrigerating plant has been built for cooling air as it leaves the compressors, and a drying plant will remove excess moisture.



THREE WHEELS MAKE MOTORCYCLE RIDING EASY

ROUGH country can be traversed comfortably on a motorcycle equipped with three wheels like the one shown in the photograph at the right. Two smaller wheels are substituted for the regular rear wheel of the motorcycle, and they run on caterpillar tractors. The third wheel is mounted on a flexible axle and swings up or down according to the nature of the country encountered. Besides making travel more comfortable by eliminating the jostling that results from traveling on corduroy roads, the three-wheel device makes it possible to plow through mud and over obstructions which would stop an ordinary machine. The device was recently tested by officials of the British War Office.



The caterpillar tractor on the rear wheels of this motorcycle enables it to cross rough country with ease.

SPEEDY MODEL

Mr. L. E. Luke, U. S. Navy radio expert, builds models of racing power boats in his basement workshop during leisure hours. Here he is putting the "tinkering touches" on a steam power boat one metre long.

By G. H. DACY

WHEN the National and International Model Power Boat races for the current year are run in Central Park, New York City, a new entry, an unknown mystery craft from Washington, is likely to show its stern to all rivals with its maximum speed of one-half mile a minute.

The idea of building racing boat models which run swiftly under their own power is not new but the matter of designing and constructing one that will make 25 knots (equivalent to 30 miles an hour) and which will run for one-half an hour and cover 15 miles with the consumption of only one pint of gasoline is extraordinary.

Mr. L. E. Luke, a radio expert in the U. S. Navy, cherishes a spare time hobby—that of building and experimenting with marine engine models. His idle-hour pastime has led to the perfection of a racing boat model which now ranks as one of the fastest midgets afloat.

The Luke boat, a crew-less craft which requires no pilot, is equipped with a twin-cylinder single action high speed engine which is lubricated by means of a displacement lubricator. This engine runs at a full speed of 25 knots an hour on 60 pounds of steam pressure. This pressure is developed by a single flue water tube Cornish type marine boiler. Mr. Luke built this boiler by hand, using solid drawn copper tubing which he brazed throughout and tested to a pressure of 450 pounds per square inch.

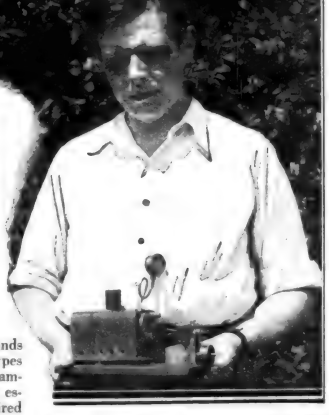
Blow Torch Fires Boiler

All the fittings and fixtures on the boiler are made accurately to scale, including a

The Cornish type single flue water tube boiler, fired by a gasoline blowtorch, generates ample steam to drive the model power boat up to 30 miles an hour. The gauge registers up to 120 lbs. per sq. in. pressure.

Power BOATS

Tethered by a fine wire to a post staked in the center of a pond, these model power boats, with real engines and real propellers, tear around the course at speeds of half a mile a minute!



pop-type safety valve set for 70 pounds steam pressure, as well as screwed-on types of steam valve and water gauge, a steam-gauge reading up to 120 pounds, and essential blow-off cocks. The boiler is fired by means of a small gasoline blow torch capable of maintaining a constant steam pressure of 60 pounds with the throttle wide open for a period of one-half an hour.

The steering of this model marine racer is controlled by a micrometer adjustment originated for that purpose. The rudder shaft has a traveling arm attached to its upper end. This arm is provided with a slot which rides on a traveling block. The block is finely threaded and operates on a corresponding machine screw which is equipped at one end with a thumb nut for adjustment. This homemade steering control system operates efficiently and is adaptable for installation on models of similar design.

The hull and deck of the dwarf size craft are made of one-eighth inch mahogany, the keel consisting of white pine carved by hand to proper curve and dimension. The power boat model is 40 inches over all with a beam of 8 inches, while its weight when stripped down for a race is only 7½ pounds. Ordinarily for general cruising, a removable cabin of mahogany provided with electric lights and a diminutive searchlight is installed. This cabin is removed during the racing season, when a hood made of aluminum is placed over the boiler.

The stem of this model boat consists of a maple arrow-head in which the mahogany hull pieces are set and then curved to the desired ship form. One serious fault in many homespun power boat models built by amateurs is that they are not protected adequately against damage from collisions. Mr. Luke has safeguarded his craft with an aluminum plate attached to the prow. It consists of a piece of metal one-eighth of an inch thick which has been anchored in the stem of the boat and then filed down to a knife edge. It serves as an effective bumper for the stem or bow of the boat.

Boiler Weighs 3 Pounds

The 2 1-2 inch propeller has a 4-inch pitch, the arrangement being such that the propeller shaft runs on ball thrust bearings. The use of this type of bearings facilitates the high speed performances of the Lilliputian boat.

Young Buddy Luke proudly holds his "Dart," shown here with spring motor before the Luke steam plant was installed.

How the Boat is Raced

The Luke boat is raced by fastening it by 50 or 100-foot line to a swivel on the top of a strong pole anchored in a reflecting pool or accessible lagoon. The instant that the guideline is taut, the stop watches click, announcing the start of the time trial. When the racer completes the necessary number of laps which may range from 5 to 10 or more circuits around the tie pole, the stop watches click again as the water speedster crosses the finish line. The distance is then computed according to the length of the line—the radius of the circular course.

In a straightaway race in a restricted pool the model boat is supplied with only enough gasoline for a short run so that it will stop due to lack of fuel before it collides with the bank at the end of the pool. Another method of racing the model boats is that of directing their courses by the use of fishpoles and lines. However, the owners have to be long-winded sprinters to keep pace ashore with their racing boats afloat. Hence this system is little used except with slow speed boats.

In addition to his champion racing boat, which is worth about $250, Mr. Luke has built another power boat for his small son to play with in the reflecting pool which adjoins the Lincoln Memorial in Washington. The "Dart," as young Luke has named his boat, was equipped originally with a coil engine containing 5 strong steel springs. Its maximum speed was 3 miles an hour and the toy engine gave so much trouble that recently Mr. Luke has designed and built an oscillating engine and a small water tube boiler which operate the Dart at a speed of 5 miles an hour. The boiler capacity is one pint of water so that the mahogany hull craft can be run only 30 minutes at a time, without replenishing water, fuel and oil.

The Dart is fired by the use of a semi-vaporizing alcohol torch. Its engine is oiled by displacement lubrication system. The boat is 24 inches long with a 5½ inch beam.

Most model boats are provided with flash steam—a blow torch focuses its heat on a coil of copper or iron tubing containing water so that steam production is almost instantaneous. Such race boats are able to maintain high speed for but 10 to 15 minutes at a time. They are subject to engine trouble because they are equipped with forced lubrication systems which fail to function whenever the control pump stops. Because of the difficulties which generally result where flash steam is used, Mr. Luke equipped his model boat with a saturated steam system. This facility supplemented by displacement lubrication eliminates the usual engine troubles which interrupt power boat model racing tourneys.

With a beam of eight inches and an over-all length of 40 inches, this 30-mile an hour model speedboat weighs only 7½ pounds when stripped for racing. A gasoline blow torch fires the steam boiler which develops a 60-pound pressure.

Tear Gas Makes Weapon of Fountain Pen

AN INNOCENT-APPEARING fountain pen containing a charge of tear gas which makes it a most effective weapon has been perfected for the use of cashiers, bank tellers, and others likely to be objects of robbery. The tear gas is carried in the pen in liquid form and when the trigger is released it spouts out of the pen as a vapor which will blind and disable anyone it is directed against. The release trigger is shaped like the conventional ink-filling lever, and in appearance the weapon cannot be distinguished from an ordinary writing tool.

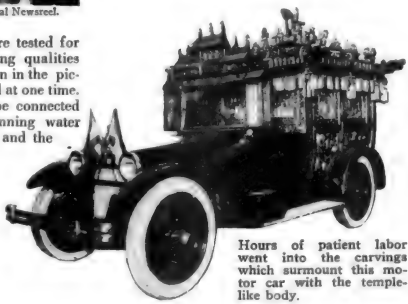
SMOKING MACHINE TESTS CIGARS

—International Newsreel.

VARIOUS makes of cigars are tested for burning and smoke-producing qualities by the mechanical smoker shown in the picture. Four cigars are smoked at one time. Each stogie is fitted into a pipe connected with a series of bottles. Running water creates a vacuum in the pipes and the smoke is drawn into the bottles, where it can be studied. The attendant is shown timing the machine, which requires about two minutes to consume four cigars. The machine is installed in the Bureau of Plant Industry of the Department of Agriculture, Washington.

CHINESE BUILD WEDDING CAR

IN CHINA no marriage is considered to have been fittingly solemnized until the bride and groom have ridden at the head of the wedding procession in an automobile similar to the one shown below. The special "gingerbread" body, decorated with gold leaf and hanging tinsel, represents an investment of about $5,000.



Hours of patient labor went into the carvings which surmount this motor car with the temple-like body.

Faking MOVIE

by DOUGLAS GRAY

TRICKS by which the movie director fakes many of his effects are interestingly explained in this article, written by a man who has been a cameraman and who is well versed in the tricks of the trade.

SEEING is believing—unless you happen to see it in the movies! The next time you step into your favorite movie theater to see some million dollar production, don't stop to marvel at the luxurious palaces and castles which you see on the silver screen, because the chances are a hundred to one that they didn't exist at all—except as a thin film of paint which fooled the gullible camera lens so completely that the innocent thing didn't even suspect it was being made fun of! This method of fooling the camera—and, incidentally, the cinema-going public—is technically known to directors as the "glass shot." The diagrams at the bottom of the page show how this trick is accomplished.

To begin with, the set for the scene is erected. In the particular instance pictured, the action occurs on the steps of a sultan's palace. All that is actually constructed, therefore, are the pillars and steps which form the doorway of the palace. A platform for cameraman and director is then built and the camera focused on the scene. Then a pane of plate glass is mounted in front of the camera as shown in the sketch.

An artist now paints the top and sides of the glass, filling in the structural details of the building which are to appear in the finished film, but which are not built by the stage carpenter. Great care is taken to fit the painting so that when viewed through the camera its edges will appear to be resting just on top of the set in which the action takes place. With everything in readiness, the actors play their parts on the set, the camera grinds—and when the movie audience views the finished picture on the

The "Glass Shot"

Only the steps and pillars of this set are built. The rest of the sultan's palace is painted on a piece of glass through which the camera photographs.

SCENES

Flying the Magic Carpet

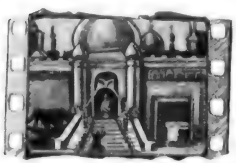
When the wires are pulled, these puppets move and their magic carpet moves with them. Although they are no taller than a human hand they seem life size on the screen.

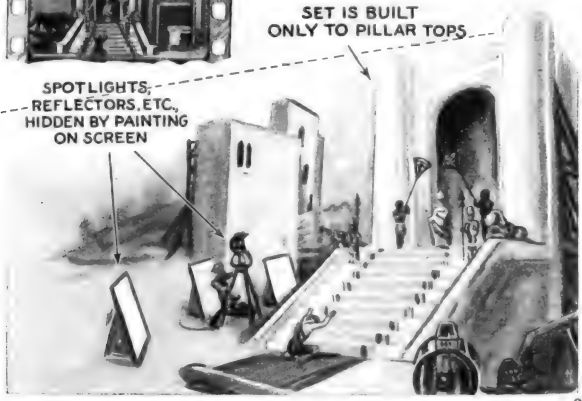
silver screen, it marvels at the expense the big producers go to in constructing elaborate buildings just to shoot a few action scenes.

Most of the big productions employ the glass shot to some extent. Among the newer films, "Noah's Ark" and Douglas Fairbanks' "The Iron Mask" use this device to gain many of their effects.

The "glass shot," of course, is not the only means of tricking the camera. You have undoubtedly seen movies in which there are train wrecks, auto crashes, shipwrecks, and all sorts of disasters, and you probably think that actual locomotives and automobiles were used. Sometimes, of course, they are; but very often what you see on the silver screen are merely miniatures built to scale and photographed against moving backgrounds. The camera can't tell the difference between a life-size sailing ship and a three-foot model, unless the two are side by side for comparison. Taking advantage of this fact, directors prefer to film their sea-scenes in a washtub, where the water is sloshed about by an electric motor which sways the tub, and the storm-tossed ship is a carefully built model

The Completed Film





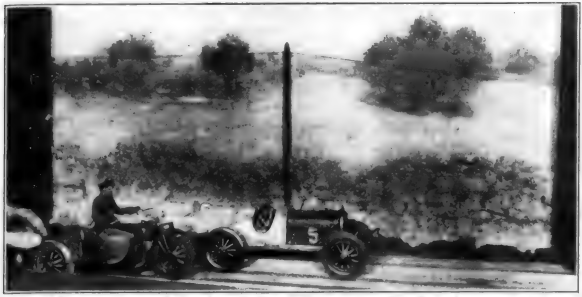
Filming a shipwreck in a washtub!

about a yard long. Large or small waves can be created at will simply by speeding or slowing the motor. When the picture is thrown on the screen, nobody suspects that the action occurred in a washtub!

Fantastic pictures showing magic carpets floating around in the sky are likewise produced through the camera's inability to distinguish between the life-size and the miniature. Tiny puppets are fastened to the flying carpet, their actions controlled by invisible wires. The puppet master causes the figures to dance and the camera faithfully records what it sees, which is a life-size carpet floating against a background of cloudy sky! Entire cities are frequently built in miniature so that the camera can shoot a few hundred feet of atmospheric background. The expense in building small sets is very much less than large ones, of course, and movie producers are business men who are not eager to throw money away needlessly.

Professional movie cameras have an attachment by which a single turn of the crank exposes but one frame of the film. When the director wishes to show an automobile race, therefore, it is a simple matter to provide miniature automobiles on a miniature track. The crank is turned once, then the cars are moved forward a short distance, and another shot is made—and so on, until the race is run.

Here we have a city street scene. The buildings are three feet high instead of three hundred. Above, a crew of workmen is putting the finishing touches on a miniature city block.

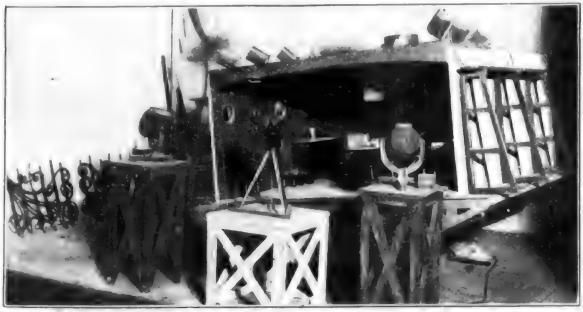


This race between cop and auto is a thriller on the screen, but the miniature models don't actually move at all. The painted background flashes past them and gives the illusion of motion. The cleverly built miniature automobiles are no taller than a man's hand.

This type of exposure is the same method followed in making animated cartoons, except that in cartoon each succeeding drawing must be painstakingly done to show a moving leg or arm in a slightly advanced position.

In the production of Sir Arthur Conan Doyle's "The Lost World," tiny replicas of prehistoric monsters were carefully made and animated by the stop-shot method. Each wink of the dinosaur's scaly eye, each gaping movement of its slavering jaws, was produced by the method explained above. Naturally the process was extremely tedious. The film required about three years for its production.

When the miniature monsters were filmed, they had in many cases to be superimposed over other "shots" showing the human actors in the story registering fear of the beasts. The relative sizes of men and monsters had to be carefully calculated, so that when the finished picture was shown the illusion of actuality was successfuly presented.



The captain's cabin of this schooner is all complete, except that it has no ship around it! The set is mounted on rockers which simulate the swaying motion of the ocean.

Cash for Crazy Ideas!

GET INTO the fun and see if you can't win your share of the $50 prize money offered each month for Coo-Coo Contraptions! Read the rules and study the contraption printed on the opposite page; then sit down and design a "nuttier" device. You may win the first prize of $25!

EVERYBODY ready for Coo-Coo Contraptions Contest No. 3! Our monthly Coo-Coo Contests have made a big hit with readers of Modern Mechanics magazine, and contributions for Contest No. 1 and No. 2 are still pouring into the editorial offices. Winners in Contest No. 1, which closed December 1, are now being judged, and the names of the seven lucky contraption concoctors will be announced in our next issue. In the meantime you still have a chance to enter your contraption in Contest No. 2, which closes January 1, 1929, or in Contest No. 3, announced herewith, entries for which must be received by February 1, 1929.

What is a Coo-Coo Contraption? If there is any doubt in your mind, a glance at the device on the opposite page should dispel any uncertainty you may have. This fresh-egg device is based on a contraption submitted by David B. McLeod of McLeary, Wash., which has been awarded a special prize of $25. Study the sample contraption, and then sit down and make a better one and send it to us. If it is a good one you will stand a first rate chance of winning a slice of the prize money for yourself.

You do not have to make a finished drawing of your contraption, although a sketch will be helpful if you wish to submit one. All that is necessary is a clearly written description of the various parts of your contraption.

Fifty dollars in prizes will be divided among the seven prize winners in Contest No. 3 as announced in the box on this page. Closing date is February 1, 1929. If your contraption arrives after this date it will be automatically entered in Contest No. 4. In case of a tie for any of the prizes, the full amount will be paid to each of the tying contestants. Prize-winners will be announced as early as possible after the close of the contest. No manuscripts will be returned. If you wish to preserve your Coo-Coo Contraption, be sure to keep a copy of it. The editors of Modern Mechanics will be the sole judges of the contest and their decision must be accepted as final.

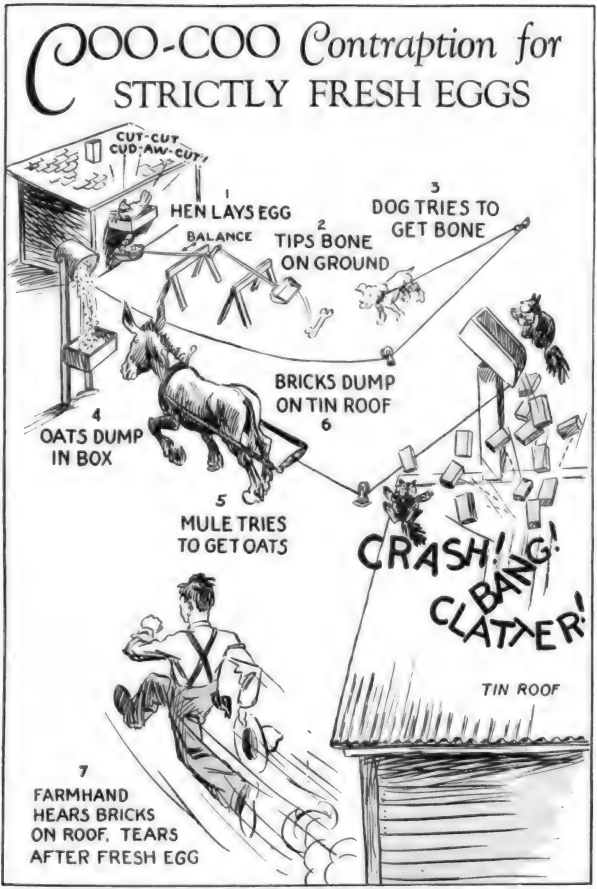
Address all manuscripts to Coo-Coo Contraptions Editor, Contest No. 3, Modern Mechanics Magazine, Robbinsdale, Minn.

The contest is open to anybody except employees of Fawcett Publications, Inc., or their families. You do not have to be a subscriber to Modern Mechanics in order to compete. Copies of the magazine are available at schools and public libraries.

PRIZES IN COO-COO CONTRAPTIONS CONTEST NO. 3

First Prize	$25.00
Second Prize	10.00
Five Third Prizes, each	3.00

Address all manuscripts to Coo-Coo Contraptions Editor, Contest No. 3, Modern Mechanics Magazine, Robbinsdale, Minn. Contest No. 3 closes February 1, 1929. Manuscripts received after this date will be entered in Contest No. 4.



Start at No. 1 and see how the contraption works!

Sliding a Mile Down

THE AUTHOR of this article tells of her thrilling ride through space in an ore bucket, swinging 900 feet above the ground with only a slender steel cable to support her. The aerial tramway connects an Oregon gold mine with civilization.

ONE of the longest aerial tramways in the world is the 4,300-foot span built by the Queen of the West gold mine in the Eagle Mountains of Eastern Oregon. The Queen of the West is located on the brink of a 1,500-foot precipice, and the cable stretches from this point to the bottom of the slope across the canyon, passing over canyons, creeks, and waterfalls which lie 900 feet below in the valley.

Until the writer visited the property several months after the tram was installed it had never been used for passenger service, being designed for ore carrying. But I wanted to visit the mine, which is located at an altitude of 7,200 feet on a mountain side whose slopes are often in excess of 40 per cent—an almost impossible climb for a woman. The mine's manager, R. G. Amidon, finally gave reluctant permission for me to ride up to the mine in the ore bucket.

The trip up to the mine was a thrilling, pleasant ride, but on the return journey things began to happen. The tram operates by gravity, a load of ore descending to the mill near the lower terminals pulls up a lighter bucket full of provisions to the buildings above. It was not deemed advisable to permit me to return alone, as it was necessary to load the bucket with ore in order to force the tram to the bottom and I had to sit on top of the load, so Mr. Amidon accompanied me.

The newly erected cable was a bit slack and our weight added to that of the ore caused the wire to sag just enough so that the tow cable caught on the projecting top of an old tower which supported a former cable. The tower snagged our car and there we stuck! We were held in this perilous position for half an hour while workmen crawled down the precipice and

A five-ton truck is shown above being transported by cable across an impassable canyon. Insert photograph is a telescopic view of the mountain side where the 4,300-foot cable is anchored. Just around the corner from the white arrow are the Queen of the West mine buildings, where Miss Parker started her slide down the mountain. In the foreground are buildings of the Last Chance gold mine.

a Mountain *by* NELLIE B. PARKER

Steam winches are frequently employed to operate cable cars in mountainous regions where other means of travel is impossible. The insert shows Miss Parker in the ore bucket just after she started her thrilling cable-car slide.

released us by sawing off the projection.

As soon as the obstruction was removed our bucket bounded back into place, setting up a vibration that lasted the remainder of the trip, a distance of 3,500 feet. It was a trip that would convince anyone that the workmen were wise when they refused to ride on the tram!

The Queen of the West mine buildings are of steel girder construction to withstand the pressure of from 20 to 40 feet of snow which completely covers them in the winter. They are built on the edge of the precipice so that sun and air can be obtained from the exposed side of the buildings. Every year the heavy snow pushes the bunk houses two or three inches nearer the 1,500-foot drop-off!

Installation of the new cable was a tedious task. When it was partially stretched it got away from the men and teams and squirmed down the mountain like an enormous snake, uprooting trees and slashing rocks with furious force.

"Vest Pocket" GOLD

By GEORGE C. HENDERSON

Have you ever wanted to mine gold yourself? Here's the way an old California miner proves his "showings" and works his claim.

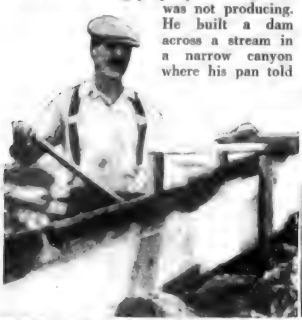
Panning Gold in California

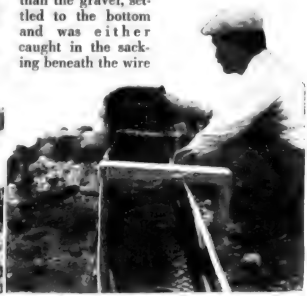
"RIVER RATTING" as in the old gold days is not all faded from memory. You can still see prospectors' burros laden with supplies, picks, pan, shovel and other tools, going down on the river. In the Sierra Nevada country when a mountain man needs a few dollars he goes down in a "cut" or a stream bed and washes out the "dust." Sometimes he will make $10 a day; often only $1 a day. It is enough to buy grub and a little "terbaccy" and the mountain man does not have to go down into the valley to work for wages, a thing he despises.

A typical river rat outfit is that of Henry Payne on San Juan ridge in Nevada County. Payne owns mining property of value, but it was not producing. He built a dam across a stream in a narrow canyon where his pan told him the soil was fairly rich in mineral; he got "color" there, in other words. He made a gate in this dam and installed long, narrow sluice boxes on the lower side of the dam, so that when he opened the gate the water rushed through these boxes. In the bottom of these sluice boxes, at the lower end of the string, he laid down sacking, and on top of this sacking he placed heavy wire screens, which he fastened down.

He also nailed cleats or riffle bars across the bottom of the boxes near the screens. Above each riffle bar he ran a thin line of quicksilver, which has the faculty of picking up and absorbing gold.

Next he turned on the water and began shoveling the gold-bearing gravel into the sluice boxes or troughs. The swift stream of water carried the gravel through the line of boxes, which are inclined, and deposited this gravel at the end of the string. This was the dump. The gold, being heavier than the gravel, settled to the bottom and was either caught in the sacking beneath the wire





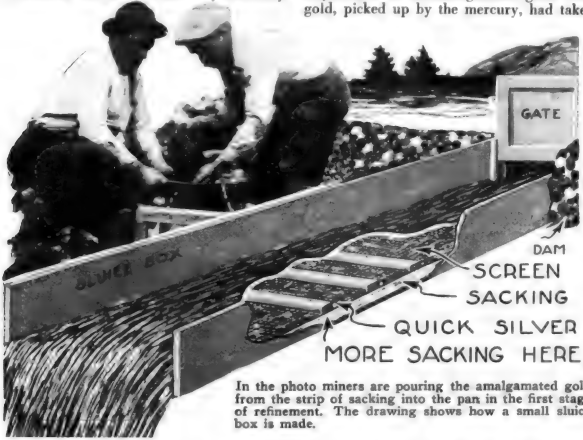
Shoveling gold bearing gravel into sluice boxes in which a swift head of water is running. On the left a miner is seen with his sluice box in which a swift stream of water is running. On the right a miner is cleaning up the amalgam from the sacking. Behind is shown the rock fill dam which backs the water up.

Mine brings RICHES

screens or was caught by the cleats and picked up by the quicksilver.

Payne shoveled vigorously. After working nearly all day he turned the water down low and prepared to "clean up." First he removed the screens and very carefully

Holding his pan very carefully to keep the jumpy quicksilver from popping out, Payne knelt near a deep clear spot on the bank of the stream and proceeded to "wash" the sand and gravel out of his pan in such a way as to leave the amalgamated gold. This gold, picked up by the mercury, had taken



In the photo miners are pouring the amalgamated gold from the strip of sacking into the pan in the first stage of refinement. The drawing shows how a small sluice box is made.

washed the bright yellow specks of color and silver bits of amalgam off of the strips of sacking into his pan.

Then with a scoop or a big spoon he scooped up the gold bearing quicksilver from behind the riffle bars, or cleats, and placed this in the pan also. Before doing this, however, he took a brush and brushed all gravel, gold and quicksilver off the bottoms and sides of the sluice boxes down to the riffles, the very slight head of water helping in this process. Finally he washed the remaining debris down to the end of the last box where the stuff was caught in a separate pail. This last consisted of tailings not so rich in gold but which still had color enough to warrant panning.

the form of many glistening silver globules that rolled like jelly. As he rolled the pan and shook it carefully, these globules joined together until presently he had a lump as large as a walnut.

Then he proceeded to wash the more elusive and finer bits of amalgam together with infinite patience. It looked like the sand he was shaking in his pan contained nothing at all. Presently a little silver globule appeared; then another and another until he had a bit as big as a pea.

The gold-impregnated quicksilver was taken up to Payne's shack and there he retorted it by heating the mercury, thus causing it to evaporate, leaving the gold in a fairly pure state.

Electric Chair Powerless to Harm Wizard

—P & A Photo.

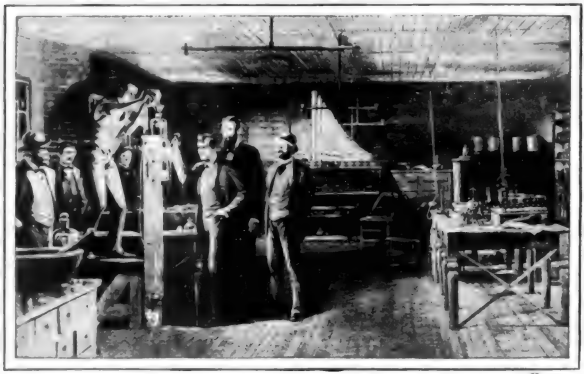
THREE hundred and fifty amperes of electric current were powerless to affect the body of Bernays Johnson, electrical wizard, shown strapped to the electric chair in which the demonstration took place. The feat was performed at the recent Aero-Radio show in Boston. The chair was of the same design as is used in the electrocution chambers of the country's prisons, and the electrical experts shown in the picture vouch for the fact that the current actually passed through Johnson's body.

One of the scientific explanations of Johnson's uncanny ability to resist electric shock, is that his skin is absolutely dry, without even the tiniest beads of perspiration moisture, and that consequently his skin is a poor conductor of current.

ELECTRIC LAMP NEARLY FIFTY YEARS OLD

A DRAMATIC moment in the history of modern illuminating science is pictured in the photograph below, showing Thomas A. Edison and his assistants testing the first incandescent lamp bulb at Menlo Park, N. J., on October 19, 1879. The lamp burned continuously for 40 hours before the filament parted. Its life was less than one-tenth that of modern bulbs whose filaments of special alloys burn in an atmosphere of inert gases instead of in a vacuum, as in the original lamp.

Edison is shown in the foreground driving the last of the gases from the bulb with with a battery. The picture was taken in Edison's old laboratory.

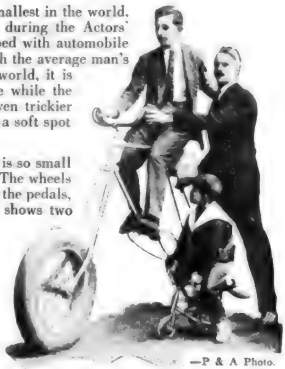


—Keystone.

France Builds Largest and Smallest Bicycles

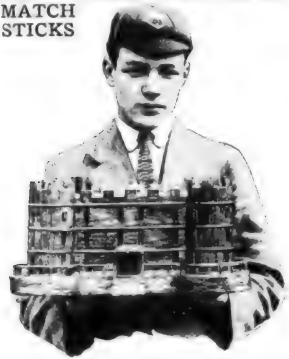
TWO bicycles, one the largest, the other the smallest in the world, were recently built for exhibition purposes during the Actors' Field Day in Paris. The large bicycle is equipped with automobile wheels and tires. The handlebars stand level with the average man's shoulders. To mount this giant of the bicycle world, it is necessary to have an assistant hold the machine while the driver climbs to his seat. Dismounting is an even trickier operation, and the wise rider foresightedly picks a soft spot in which to apply the brakes.

The tiny bicycle shown beside its big brother is so small that even a youngster has difficulty in riding it. The wheels are only six inches in diameter, and when turning the pedals, the feet almost touch the ground. The picture shows two riders about to lead a parade.



—P & A Photo.

YOUTH BUILDS CASTLE OF MATCH STICKS

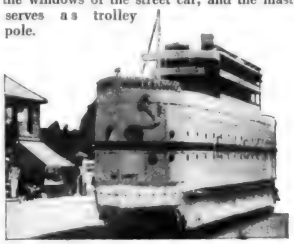


THOUSANDS of match sticks were used in constructing the model castle shown above in the hands of its maker, C. W. Spice, an English school boy. It took him a year to build it. It is a faithful reproduction of Sulworth Castle, a well known medieval English building. Young Spice gathered used matches throughout the neighborhood to procure enough lumber for his castle. The completed building is an unusually substantial and attractive example of the model-maker's art.

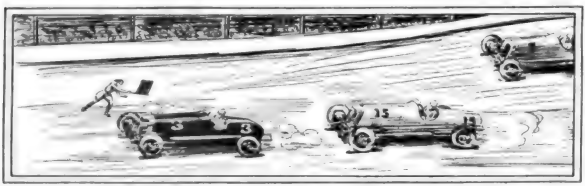
DRY LAND SHIP IS STREET CAR IN DISGUISE

LOOKING at the picture below, it would appear that some shipmaster made an error of judgment and steered his craft right up the middle of a busy street. As a matter of fact the "ship" is an ordinary street car which has been dressed up for use at a seaside resort.

The portholes of the ship correspond to the windows of the street car, and the mast serves as trolley pole.



New Racing Cars Do



By RAY F. KUNS

FOUR hundred feet in the wink of an eyelid—that's what the modern racing car can do! The story of the development of these 250 mile an hour cars is fascinatingly told here by Mr. Kuns, who knows the racing game as few men do.

EIGHT MILES an hour, 20 miles an hour, then 30, 40, 50, 75, a hundred —and now 250 miles an hour, or more than four miles a minute! This is the incredible accomplishment of the racing automobile, which was born upwards of 30 years ago and which today has attained a degree of perfection undreamed of by Barney Oldfield, Ralph DePalma, or those other daredevil drivers of the old dirt tracks!

Automobile racing is a game which calls for youth—clear-eyed, undaunted youth, eagerly seeking new ways to speed up their pampered mounts of steel. It is worthy of note that most of the leading race car drivers are less than half way through their twenties. Yet it is young men such as these who not only drive their cars at terrific speed over the board tracks, but who sit down with the engineers and devise new attachments, new accessories, new kinks which will give just an added ounce of power to their engines—an added ounce which ofttimes means the difference between success or failure on the race tracks.

Loading Frank Lockhart's 235 mile an hour Black Hawk Special with cube ice, used for cooling. Note the stream lining around the wheels and over the steering knuckles.

There is, for instance, the case of Frank Lockhart, one of the greatest of them all. The greatest loss suffered by the racing fraternity during the 1928 season was his untimely death when he was thrown from his car and killed last spring at Daytona Beach, Florida. The developments which make it possible to drive the tiny 91.5 cubic inch displacement cars at such terrific speeds as 171 miles an hour (which speed Lockhart attained with his little track racer on a dry lake bed in California) were largely the result of Frank Lockhart's engineering genius.

Lockhart was the first driver to conceive the idea of cooling the incoming charge of gas so as to force more of the charge into one of the little engine cylinders, which have aluminum pistons about as large as a tailor's thimble. He developed the air-cooled

Four Miles *a* Minute

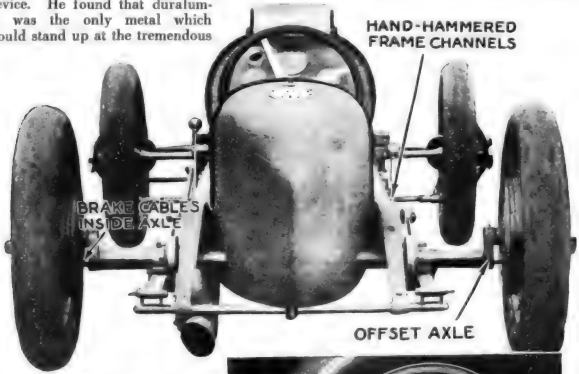
intake manifold and used it for almost a year before secret of his amazing speed leaked out.

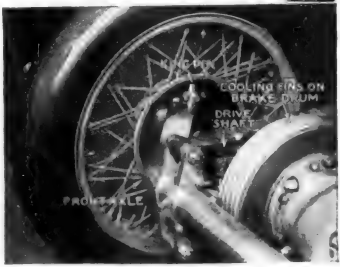
Lockhart also built his own superchargers, which are used to force the gasoline charge into the cylinders.

He found that the centrifugal force of the weight of a steel impeller was sufficient to stretch the steel blades an eighth of an inch in length and thus wreck the whole device. He found that duralumin was the only metal which would stand up at the tremendous speeds he demanded of his product; over 40,000 revolutions per minute, which would mean a point on the edge of the impeller would travel at the terrific rate of 17 miles a minute.

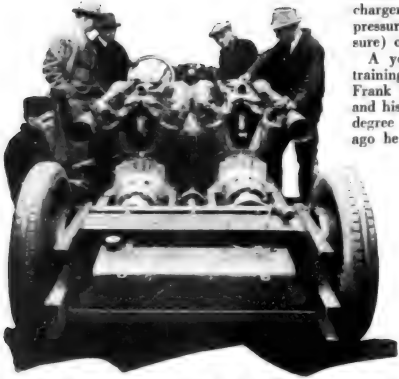
In his tests with the supercharger, Lockhart found that only certain types of ball bearings would stand the strain. He also found that one of the most popular of the six-cylinder automobile engines, did not develop enough power to drive the impeller alone at the rate he desired. Yet by the aid of the supercharger he was able to develop almost 200 horse power from eight cylinders and a displacement of 91.5 cu. in.

In his Daytona Beach Black Hawk Special Stutz racing car, Lockhart had what was admittedly the fastest car ever built. When laying out this car he built a model, exact in all details of contour, and took it to the Wright Field at Dayton, Ohio, and tested it in the wind tunnels at rates up to and above 200 miles per hour. After a numb-





A modern racing car with front wheel drive is shown above. Note how the steering and driving mechanism is combined.



This 36-cylinder Triplex Special made an unofficial record of 253 miles an hour. It is powered with three 12-cylinder Liberty motors and has no transmission, being direct driven from crankshaft to rear axle. J. M. White, who built the speed demon, is the man with his hand on the steering wheel.

of tests and changes, he developed the streamlining used in the racer which has an unofficial record of over 225 miles per hour.

The engine for this Stutz Black Hawk was a combination of the two used in Lockhart's regular racing cars. It was a sixteen cylinder job. The two crank shafts were used in one crank case. Each crank had a large gear fitted to its front end, which in turn was fitted to another gear which was on the propeller or drive shaft in the crankcase. This shaft was located at lower center and went back to the clutch shaft.

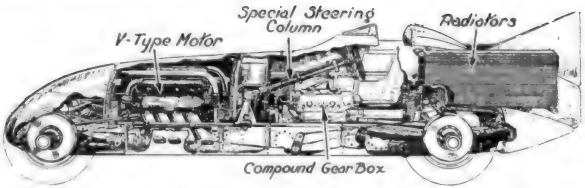
The job was ice cooled. The 80 pounds of ice was sufficient for the tests which were run. The entire length of the run was about nine miles. Four miles to gain speed, one mile measured course over which the car was electrically timed by the A. A. A. racing committee, and four miles in which to slow down and turn. Two superchargers were used. The air from the superchargers was cooled before induction into the engine. Lockhart claimed that his superchargers would give an effective pressure (above atmospheric pressure) of 27 pounds per inch.

A youngster without engineering training of the catalogued type, Frank Lockhart developed himself and his loved racing cars to a high degree of efficiency. About a year ago he went with the Stutz factory as an engineer. There with his own equipment and own mechanics he "set up shop." His loss is a great one. He gave his best. He contributed more in his short racing career to scientific knowledge of methods of overcoming wind resistance in automobiles and putting power into engines, than most engineers do in a lifetime.

Daytona Beach, where Lockhart was killed, is the favorite speed track of the world's best drivers. Malcolm Campbell, an Englishman, came over with his great Bluebird car and set up an average speed of 206 miles an hour. Campbell built his car himself. The Bluebird is a 900 horsepower machine with several novel features which may best be explained by the diagram on page 101.

Another unusual racing car is the Triplex Special, built by J. M. White as a sporting venture, and driven by Ray Keech. Because it possessed no reversing gear, the Triplex was barred by the A. A. A. from participating in the official races, but the huge 36-cylinder machine set up an unofficial record of 253 miles an hour—better than four miles a minute!

There is no transmission, no rear springs, no gear shift levers in the Triplex. It is stripped down to the essentials—a power plant on four wheels. The car is direct driven from crankshaft to rear axle. It is powered with three Liberty motors, each having 12 cylinders. It develops 2,500 horsepower—contrast this with the strength of the average railway locomotive, which develops only 800 to 1,000 horsepower! The

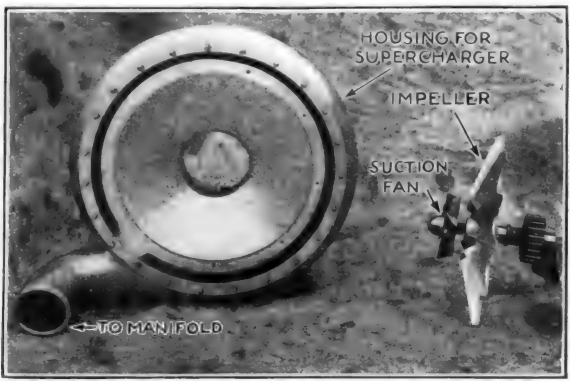


The unusual design of Malcolm Campbell's Bluebird is shown by the diagram above. Note the radiator placed above the rear wheel. The detachable fin at the tail of the ship helps to keep the car on its course at high speeds.

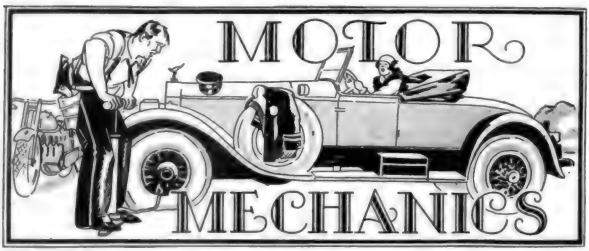
motors turn over at 3,300 r. p. m. without load, a speed equivalent to 375 miles an hour.

In his Black Hawk Special, Frank Lockhart attained 235 miles an hour. The Englishman, Colonel Segrave, attained 204 miles an hour last year with his 1,000 horsepower Sunbeam. These speeds, of course, were only maintained for a few miles. In the Indianapolis speedway races the 500 mile jaunt is usually negotiated at an average rate of 100 miles an hour.

Racing is a young man's game, with the emphasis on the young and again on the man. A young fellow may enter it with little in a monetary way if he has the requisites of steady nerve, strong physique, brains in an automotive way and an indomitable spirit of never quitting, and have a fair assurance of success.



The suction fan of the super charger, parts of which are shown above, draws gas from the carburetor and feeds it to the impeller blades, which forces the charge at high pressure into the cylinder. The impeller blades make 40,000 revolutions per minute!



Conducted by **RAY F. KUNS**

Automobile owners interested in getting the utmost service out of their cars will find the monthly comment of Mr. Kuns in this department extremely valuable. For many years Mr. Kuns has been director of the Automotive Trade School of Cincinnati, Ohio, and he knows automobiles from radiator to tail light.

Proper Clearance Important in Fitting Pistons

THE RULE for cast iron pistons, of the light weight type now used, is to allow from .00075 to .00125" clearance per inch of diameter of the cylinder for the skirt of the piston. There must be more clearance around the ring lands and across the head of the piston.

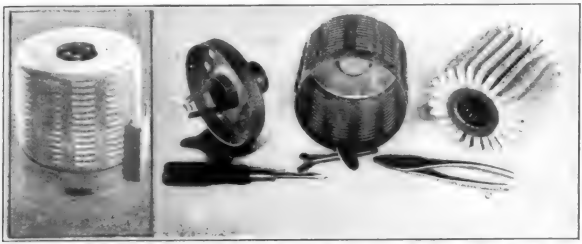
The first thing to do when preparing pistons for a newly overhauled job, is to see that the cylinder bores are true and smooth. Next select pistons which will fit the bores with the allowances suggested above. Use a strip of shim material, thin brass, or a strip of steel for the thickness or feeler gauge as shown in the photograph. This strip for a Ford Model T car should be .003" thick and placed in the cylinder in such manner that the piston may be slid in against it. If the piston is too tight the best way to reduce it is by using it for a lap, using fine grinding compound. If the job is for a truck or for high speed service, give not less than .004" clearance.

Above is shown the use of a thickness strip in testing piston clearance. The insert illustrates how a piston is scored from too little clearance.

The ring lands and head should be relieved about twice the amount provided for the skirt. Wherever lapping is resorted to, scrub the block and pistons thoroughly with a stiff bristle brush and kerosene before final assembly.

There is no advantage in fitting new pistons too tightly, since there must be a certain amount of clearance if the piston is to slide in the cylinder, and if this clearance is not allowed in the fitting the piston will soon be worn down to the proper dimensions through contact with the cylinder walls.

CLEAN the AIR CLEANER!



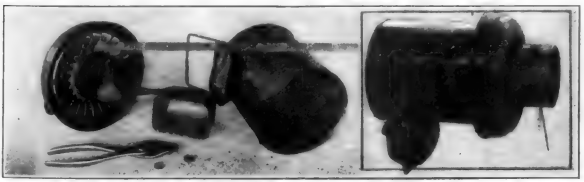
This type of air cleaner strains the dirt from the air by means of the heavy cloth fins. At the left is the complete cleaner; the rest of the picture shows the disassembled cuts.

TWO TYPES of cleaners are shown in the accompanying illustrations. It is not necessary to have any tools to open them up to clean them. They are shown here in disassembled views to inform the reader of their construction.

Dirt entering the type of cleaner shown below is carried by the air passing through the spiral fluted fins indicated at the end of the rule and is thrown out of the air due to centrifugal force of the rapidly turning air currents. These particles of grit and dirt are trapped in the little metal box mounted under the wire clamp at the bottom of the cleaner. Remove the small trap by pushing the wire to the side and clean it once a year, oftener in severe service.

The other type of cleaner depends on a heavy cloth strainer to sift out the dirt from the air, thus preventing the formation of carbon and scoring of working parts. A thumb screw at the top of the shell covering the cloth is turned off and the outer cover removed. A clean dry brush is used to brush the accumulated dirt from the cloth. This cleaner, too, should receive attention if it is to perform the service for which it is intended.

If your car is provided with an air cleaner, check up its condition and be sure it is not so clogged that it is not in working order. Remember that the air which passes into your carburetor and thence into the cylinders of your car is often loaded with tiny dust particles which can badly damage your motor.



Centrifugal force is the principle employed in this type of air filter. The rapidly revolving air currents throw the dirt into a collecting box.

Paper Shields Protect Cars From Garage Dirt

COVER alls mean protection. Even cars are dressed up in them these days when they go to the garage to have the carbon removed or the brakes relined or any other operation which entails a lot of grease and dirt.

These cover alls come in sets—for the seats, the inside of the doors, the steering wheel and so on.

They are a very great convenience to the garage man and then when "my lady" comes to the garage for her car she does not find all of the transmission grease and carbon exactly where she expects to place her gloved hands.

For safety's sake keep the horn properly adjusted. Add a few drops of oil about once a month. In case of accident, the fact that the horn was in working condition is a strong point in favor of the owner.

MOTOR BUS TRANSPORTS RACING GREYHOUNDS

A SPECIAL motor truck built to transport greyhounds from one race track to another has been constructed for a London racing association. Each dog has his own comfortable kennel well packed with straw as protection against road jolting. As the photograph shows, there are two tiers of kennels on each side of the truck with accommodations for five dogs in each row, giving the dog bus a capacity of 20 passengers. A special ventilating device at the top of the kennels assures the greyhounds a plentiful supply of fresh air. The dogs are reported to have taken kindly to the new method of transportation.

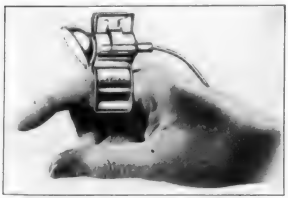
OIL CLEANERS NEED FREQUENT INSPECTION

IF OIL in the engine shows black, it is an indication of carbon. Many cars are provided with oil cleaners. Oil is by-passed to these cleaners. After a time the cleaner will become filled with carbon and an accumulation of other dirt. Accordingly when the oil in the engine shows a tendency to become dirty, it is time to have the cleaner inspected and not infrequently it will be necessary to replace the cleaning element.

Back Seat Control Shows Beginners How to Drive

COPYING the dual control idea from army training planes, a back seat drive with steering wheel, clutch and brake pedals has been built into an automobile by an enterprising dealer to help beginners learn the fine points of driving their new cars. The photograph shows how the back seat controls are built into the car. This system of instruction has proven unusually efficient.

TROUBLE LAMP FITS FINGER



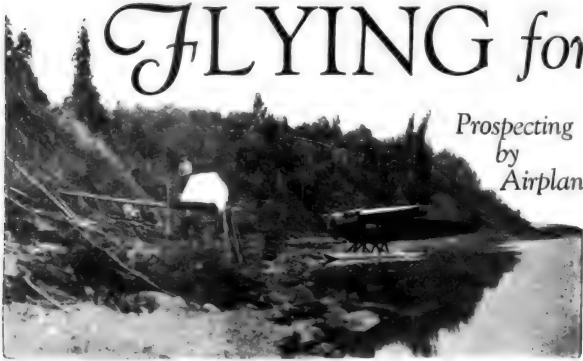
EVERYONE who has had to repair a piece of machinery at night will appreciate the advantages of a new trouble light recently invented. The electric lamp is so small that it can be clamped to a finger of one hand, thus enabling the worker to use both hands and direct the light where needed. Wherever the hand goes, the light goes.

PARKING PROBLEM SOLVED!

IF you can't find a parking space big enough for your automobile, turn the car up endways! This is the solution of the parking problem devised by the group of collegians shown in the picture.

Try this stunt the next time you want to park your car.

FLYING for Prospecting by Airplane



Lakes in the gold country furnish ideal landing places for the pontoon-equipped planes used in transporting prospectors and supplies to the scene of a "strike." Here is a landing base on a lake in northern Ontario. Note the gasoline drums.

USING airplanes which cover in half a day the territory which dog teams require a month to cross, modern prospectors are opening up the richest gold-bearing country in the world—the isolated Pre-Cambrian area of Canada. Mr. Kneen, a mining engineer, here tells the thrilling story of the methods used by the world's first aerial prospectors.

INTO HUNDREDS of remote creeks and hidden hollows of middle Canada, men today are swooping down in airplanes. Upon rivers and lakes, which have known only the ripple of the trapper's paddle, great roaring birds alight. Wild forests and barren hills echo to the thrumming of high-powered motors. Flying prospectors of the north are raiding nature's greatest treasure-house.

Four years ago it was otherwise. One night in 1924 a telephone bell jangled. It was a call for "Jack" Hammell, who has some claim to the title of master prospector of Canada. At the other end of the wire, in some distant outpost, was his prospector friend Lorne Howey.

"I've struck something good," came Howey's voice, perhaps a little shaky. "And say, Jack, will you handle it for me?"

Hammell said No! He was already well supplied with mines, prospects and hopes. But Howey stayed with it, unmindful of long-distance tolls, and Hammell gave in. The next summer he and a companion loaded a canoe "to the guards," and in the combined carry-all and burro of the lake-country, started up river to see what Howey had struck.

Day after day they paddled upstream. A sudden storm caught them in the middle of Gull Rock Lake. More than once they missed an ice-cold bath by the proverbial hair, but they weathered it, and in time reached their prospect.

It looked so good that the next winter Hammell took a party of miners, along with the indispensable geologist. They went in by dog-team, the thermometer reading around forty below. It was the first winter trip ever made into Red Lake. The geologist, soon found that Howey knew gold when he saw it. Hammell's next job was to reach the railroad.

GOLD by ORVILLE H. KNEEN

Tedious trips by dog-team don't worry the airplane prospector! The plane in this picture reached its destination in half an hour; the dog team pulled in three days later!

Plane Cuts Dog-team Time

He sent Doug Wright with a dog-team to Hudson, end of the rails. Three days later Hammell was picking over the dogs, getting ready to follow Wright, when he heard a throbbing, then a roar, as a big plane settled on the frozen lake. It was the first plane ever seen in winter on that lake.

Hammell got acquainted with the pilot in less than no time. An hour later he was in the air, headed for the rail-head. Another half an hour, and he saw a dog-team plodding along the trail. Hammell shouted to the pilot, who nodded in reply.

Suddenly they swooped down, just over the heads of the plunging dogs. As driver, dogs and sled, landed in a general free-for-all, alongside the trail, the plane roared out of sight, drowning out any caustic comments that might have been made.

Another half hour and the plane was in Hudson. It was three days more before Wright mushed in. When Hammell stepped up and asked him where he had been, it is reported that Wright turned pale under his northern tan.

That was a striking example of airplane versus dog-team. The Howey property today, beginning its development, is valued at several million dollars, and it has the distinction of being the first to "get off to a flying start." The airplane in the brief period since, has come to be Hammell's standard mode of transport, summer and winter, into regions remote from rail.

ONLY two per cent of Canada's Pre-cambrian mineral areas have been prospected to date—yet this area of bed-rock, exposed by the ancient glaciers, is one of the richest mineral-bearing regions in the world! The barrier to exploitation has been that the country was so remote that prospectors could only work for three or four months during the year. The rest of the time was consumed in making the long journey to the field and returning before the bitter winter set in. But now a fleet of twelve airplanes makes regular journeys to the gold country, carrying supplies and equipment so that operations can continue without interruption. So has aviation put the romantic occupation of the prospector on a business basis!

Captain H. A. Oaks, director of aerial operations for the first flying prospectors, told me of his work. His aerial operations, I learned, consist of getting Hammell and his numerous gold-seekers into and out of localities where "things look good." He has been flying in Canada ever since the Armistice.

Captain Oaks told

Airplanes Help Lonely Prospectors a Thousand Miles

EVEN though airplanes have eliminated most of the prospector's transportation difficulties, the game is not one to appeal to weaklings. Ice-cold rivers must still be forded now and then; camp must be pitched in inhospitable places, and luxuries are limited to a few tins of tobacco and an extra pair of woolen socks!

Above is shown a prospector's transport plane just after landing. It carried three men and supplies enough to last the camp for two months.

Jack Hammel, master prospector, is shown above frying flapjacks. The type of river boat shown in the picture at the left was formerly the most rapid means of getting into the wilderness.. And when you got there you had to cross swollen brooks on horseback before you reached the gold country!

me that a dozen Fokker monoplanes, with extra large tanks and heated cabins, have just been added to the "flying stock"—at a cost of around $30,000 delivered. They are guaranteed to stay aloft for a thousand miles on a tankful of gas, to last five years in prospecting or 2½ to 3 years in transport service. Hammell has just bought a fast Fairchild with a radius of 700 miles. All are painted an appropriate golden hue.

"Leaving New York today," said the Captain, "we can in three weeks have a copper mine fully located 2,000 miles from here. In fact, that is what we plan to do. The men will arrive fresh and ready for work. One plane provides complete transport service for ten parties. Then we can 'size up' the country as we go, and if the ground doesn't look good, we pick up and move. A canoe or pack-train outfit would be stuck for the rest of the season."

Perhaps the first thought that occurs to one, in this rather amazing form of gold-seeking, is the problem of landing. Captain Oaks pointed out how well Canada is prepared for the airplane.

"Notice the hundreds of lakes," he said, pointing to the map. "In the summer they are the finest of air harbors. In winter we use skis and land on the frozen lake. We

From Civilization to Do Eight Years Work in One!

carry our own design of collapsible canvas canoe, also an outboard motor, and even a sail, in case we get stalled in the middle of a lake. We get into the field about the middle of May, whereas the canoe or pack-train cannot make it before the first of July. The plane makes one working season equal to about eight under the old system."

It sounds simple and safe. But we know something of the winter weather that drops in on parts of northern Canada. Of what use is an airplane when fogs roll in, when the thermometer freezes solid, when blizzards sweep down from the Arctic and heavy snow fills the frigid air? I learned with surprise that flights have been made under just such conditions.

Winter Flying Perils

One winter, before the plane became the flying burro, HammeH was caught at Red Lake (some 250 miles east and north of Winnipeg). It was over a hundred miles to the railroad, and he was in a hurry. But the weather was cold, and every plane was frozen in or laid up. Knowing the reputation of "Doc" Oaks, who was then operating a taxi-and-freight service from "Anywhere to Elsewhere," Hammell got through a wire to Oaks at Winnipeg.

The Captain was willing to fly, as he always is. But it took some time to locate a suitable plane, a Fairchild, and still longer to get a Wright Whirlwind motor that would make it fly. By the time he had them assembled, a blizzard descended. It kept him inside for days. When it began to let up he took off, against the earnest advice of his friends, and duly arrived at Red Lake. Soon he and Hammell were in the air, headed for Hudson. All went well for a while.

But all at once ice began forming on the wings—the most dreaded hazard of northern flying. As the weight increased and the wing-form changed, they began to drop toward the evergreens and snowfields. They hove into sight of the railroad, still losing altitude, when the pilot shouted into the ear-muffs of his "fare":

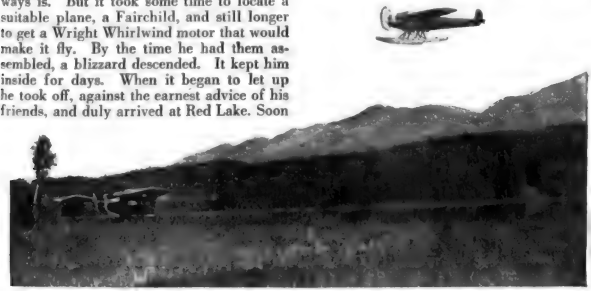
"I'll have to crash 'er—hang on and pray for little trees . . ."

Hammell gripped the fuselage and braced himself as the plane nosed for a clump of spruce. They skimmed the snow-encrusted tops. Oaks tried to shift his control-stick, but could not budge it. A second or so of splutter, as he cut the motor off, then the plane flattened out ever so slightly, sailed over the last tree, and slid to rest on the ice.

This narrow escape was caused by landing on a spot at Red Lake where water was unfrozen. A few drops which had splashed in caused the controls to freeze solid. That is why flying is rarely attempted in the short period "between seasons."

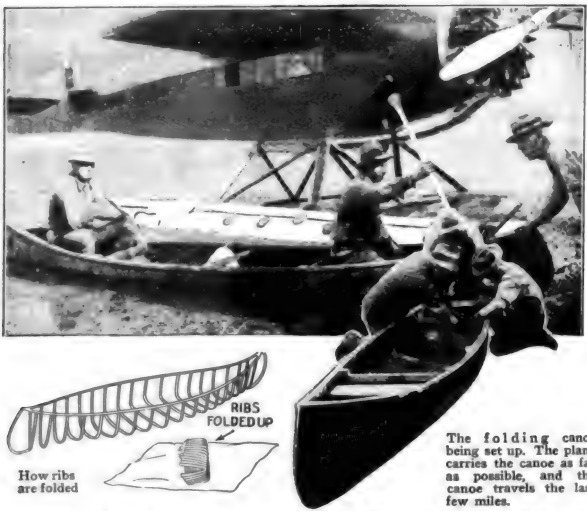
A Mountain of Nickel Ore

John E. Hammell "breezed in" while I was talking with the Captain. He is a big, brawny product of a hard life, solid proof



Mountain-rimmed lakes like the one above are used as bases by the aerial prospectors. From spots like this men set out on foot looking for pay-dirt in the hills. The Nikinai mountain range of northern Ontario can be seen in the background.

Airplane Carries Folding Canoe for Prospectors' Use



How ribs are folded

The folding canoe being set up. The plane carries the canoe as far as possible, and the canoe travels the last few miles.

that muscle and health are the first requirements for a northern gold-hunter. His voice boomed along at a hundred miles an hour as he explained how the prospector takes to the air nowadays.

"I've been prospecting for twenty-two years," he said. "All the boys are my friends. I grubstake a lot of them, and they go out in canoes as soon as the country opens up in the spring. Each man works his own locality, and when he finds something, he lets me know. That's where the plane comes in.

"We have four bases, about five hundred miles apart, two of them at Le Pas and Golden Pines, about a day and night north of Winnipeg, our main base. With a geologist, engineer and camp equipment, we can soon find out the size of a strike, and even fly out with samples. There are some two million square miles of the Pre-cambrian—that's the bed-rock exposed by the glaciers—and we have some of the world's richest placers. There's plenty more in sight. We have, for example, a whole mountain-top of nickel ore."

In spite of the very healthy looks of the master prospector and his flying chief, I felt that both hazard and adventure must accompany aerial prospecting in the north country. But the ex-war pilot could not see that there were any real risks involved. Perhaps his combat experience made any other kind of flying seem tame by comparison.

"You see," explained the Captain, "we keep at a high elevation. If the engine stalls we can find a lake or river almost anywhere within five miles. Our longest flight so far was only 270 miles. We have flown 200,000 miles, summer and winter, during fourteen months, without an accident.

Forced Landings Are Rare

"Of course," he conceded, "northern flying has its interesting moments. I recall getting a wireless at Winnipeg, from a mine in Central Manitoba, that a miner had his skull fractured. To save his life he had to be in a hospital in 48 hours. It was a very dirty day, with a blizzard and a heavy snowfall. We bucked it that way for two hundred miles, but we got the miner onto the operating table in time.

"Another time I was forced down about a hundred miles from Hudson. We broke a ski against a log when we landed, likewise the under-carriage. But we had our dogs along, with eider-down bags, food and things, and in ten days we mushed out to the railroad. All our planes carry such equipment, even to axes, rifles and snowshoes. So you see there really is little hazard to flying the way we do it."

I was not entirely convinced, however. "But suppose," I remarked, "that you were forced down and your plane burned leaving you without food, axe, sleeping equipment or even a gun?"

"We had one plane that burned," he rejoined, referring to the taxi-service, "but the pilots saved some rations and supplies. There was a storm for four days, and having eaten all their food they were just starting out on foot when the relief plane spotted them. We have an emergency signal, made by laying a triangle of green branches on the white snow, that we can spot from 4,000 up on a good day.

"Of course, it *might* happen that they saved nothing from a burning plane. But all our pilots carry matches in a waterproof box, and they all know how to live off the country. They can make a good shelter with branches. With a gun they could get plenty of porcupines, rabbits, partridge, maybe a moose. In the north there are cariboo, in the south deer and timber wolves. Minus a gun, they would have to make a fishnet, and with a piece of wire they could snare an odd partridge or rabbit. Mostly they would depend on fish, of which there are plenty."

It is this type of resourceful and fearless gold-seeker, in rugged machines that fly even at fifty below, who has conquered the northern wilderness. Sweeping over mountains and canyons and swamps, directly to fields heretofore inaccessible, he is the flying scout of a civilization built upon minerals, and ever crying for more. He is crashing the gateway to wealth, swooping into the Empire of Treasure—in the heart of a land once considered utterly worthless!

Here's the way they dress for winter in Canada! These three men are members of the Royal Canadian Mounted Police, standing in front of their winter quarters.

Plane Talk

MAJOR ARNOLD

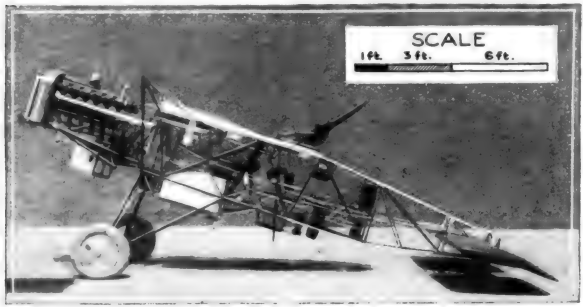
by Maj. H. H. Arnold

One of the best known authorities on aviation, Major Arnold's expert comment in this department is meeting with an enthusiastic reception from air-minded readers of Modern Mechanics. During the war Major Arnold was Assistant Chief of the American Air Service. He knows what he is talking about when he speaks of aircraft!

Modern Airplanes Have Steel Tube Fuselage

ALTHOUGH the "stick and wire" type of construction of airplane fuselages was generally accepted as the orthodox practice for many years, there were a few pioneers who believed in metal members for the important spans. One of the first of all metal planes was the "Red Devil" built in 1910 by Captain Tom Baldwin.

This plane was the pusher type and fitted with a Curtiss engine, but Baldwin used metal spars and struts wherever possible. At that time the art of manufacturing steel tubing was not advanced as far as at present and Duralumin was an unknown metal. Accordingly many pounds additional weight were added to the plane over that



This photograph of a modern combat plane shows the construction of the all-metal fuselage. Metal construction has largely supplanted the old "stick and wire" type.

Old Pre-War Type of "Stick-and-Wire" Airplane Fuselage Obsolete

of a "stick and wire" type.

Even before the World War it was realized that aviators would have a better chance to escape uninjured in a crash if it were possible to develop a light, sturdy, easily worked metal construction which could be maintained without any great difficulties.

Immediately following the war, designers and constructors began their experimental work with a view of producing at least partially constructed metal planes.

There are two types of so-called metal planes. In one the main members are all metal but the wings and fuselage are covered with fabric. Wooden members are used in the wing construction. In the other practically every part is metal. The wing and fuselage are covered with very thin duralumin sheet, .010 or .013 inch gauge. Duralumin is the name given to an alloy of aluminum which contains copper, magnesium, and manganese. Dural weighs about 35% as much as steel, but has practically the same strength in tension and bending as low carbon steel.

A close-up view of the skeleton construction of the machine gunner's cockpit in a new war plane. Note the entire absence of wood in the design.

Thus Dural has the advantage over steel in being lighter but has the disadvantages of being much harder to work when annealed, and of being impossible to weld and not as readily obtained. Thus when a metal member is bent or broken in a plane away from its base, a new steel member can be put in place without any trouble in almost any small town, but with Dural it is necessary to straighten or strengthen the damaged part or possibly to send the entire plane back to the factory.

The steel construction is very simple. The members are cut to the proper size and then welded together. This welding is done either by the oxy-acetylene or electric process. Both are equally strong and cheap. However, in all welding jobs the strength of the finished product is entirely dependent upon the skill of the welder.

Modern airplane construction practice has almost entirely eliminated wood in the fuselage. However, the question of all metal or part metal wings is still an open one. The enormous number of rivets required in fastening the metal sheeting to the wing greatly increases the labor.

Temperatures must be kept constant in airplane wing doping rooms like that shown above. Special ventilating equipment is required so the fumes will not overcome the workers.

Development of Airplane Wing "Dopes"

THERE were many different ideas as to the proper material which should be applied to fabric wing coverings on the early airplanes and airships. With the balloons the practice of using rubberized cloth had been accepted as the best. Zeppelin solved the problem of securing a material which was impervious to gas by lining his gas cells with gold beaters skin. This is the interior lining of the intestines of cattle. However, gold beaters skin was too heavy and not sufficiently durable for airplane use.

The Wrights started out on their first planes by using rubberized fabric. This material was fairly satisfactory but had the disadvantages of being too heavy and of loosening up under certain weather conditions. One of the requirements of airplane fabric is that it shall be sufficiently taut under all conditions to provide a stream line section for the wing.

Many other expedients were tried out to secure a taut, weather proof fabric which would be workable and yet impervious to the air, but none were entirely satisfactory. One constructor tried out a paraffin preparation. He applied this preparation in the morning and then let it stand for a couple of hours to dry. When he returned in the early afternoon, he found that the sun had melted the paraffine and his fabric was like a wet dish rag. Others tried out mixtures made up of glue and varnish but the rubberized cloth was the most satisfactory for several years.

During the first few years, dope was made from either acetate of lime or cellulose acetate. It might be said that the kind of acetate used was dependent upon the availability of the product. During the World War the United States had to create a new industry for the manufacture of dope. Prior to that time it was all imported. Thus many factories sprung up in the middle west where corn stalks were plentiful. Other factories were started in regions where wood distilleries were already operating.

Dope is now considered to be an essential part of all airplanes. It gives the fabric, if applied properly, a smooth, taut, waterproof, non-inflammable surface which is resistant to weather and also to gasoline and oil.

The fabric used is ordinarily either unbleached linen or high grade long staple cotton. This cloth is cut to fit the form of the surface and attached as tightly as possible. The dope is then applied either by brush or spray. The dope dries very quickly, tightening the cloth as it dries. Four or five coats are applied to secure the glossy surface now so well known and expected on all airplanes.

New Airplanes Carry 30 to 40 Instruments in Pilot's Cockpit

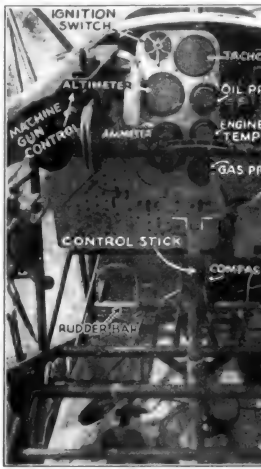
WHILE aircraft instruments are taken today as an accepted fact, it was not many years ago that their use was the exception rather than the rule. As the balloon and the airship were both developed long before the airplane it was but natural that the first of all aircraft instruments should be designed for lighter-than-air craft. Thus we find the mercurial barometer was used in balloons to determine the altitude at which they were drifting only a few years after the Montgolfiers sent the first balloon into the air in 1783.

The mercurial barometer was not entirely satisfactory on account of its weight and the inconvenience attendant to its use. Thus the aneroid barometer made its appearance in 1845 and although it was less accurate, continued to be used during the subsequent development of aircraft.

When Andree made his attempt to reach the North Pole by balloon in 1897, he carried a compass and a bubble sextant with him. Some thirteen years later, Walter Wellman attempted to reach the North Pole and also to cross the Atlantic in an airship. He also had a few instruments in his dirigibles. These early instruments were similar in their basic principles and operation to the present day types.

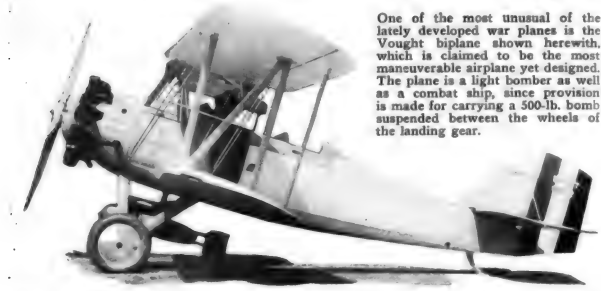
However, the major developments and refinements of all aircraft instruments have been made during the past ten or fifteen years. The early German Zeppelins had certain practical instruments, but even those were further improved to meet present day requirements. These instruments were not used in the early airplanes for several reasons,—they were too bulky; no one knew exactly what instruments would be required by airplanes; no one could predict the ultimate use which would be made of, or the ultimate performance of airplanes.

The first of all airplanes had no instruments at all installed. When the Wrights desired to find out the efficiency of their engines they used a hand revolution counter and a stop watch. Other pioneer airplane operators would fasten a spring scale to the tail of their planes and read the pull on the scale when the engine was running wide open. The heights attained by the first airplanes when making altitude flights were determined by requiring that the planes fly over captive balloons. The lengths of the



Here are a few of the instruments an airplane pilot must watch! The perforated housing directly under the machine gun control is the chamber through which the bullets are fed.

Army's Smallest Bomber Carries 500-Lb. Bomb in Landing Gear



One of the most unusual of the lately developed war planes is the Vought biplane shown herewith, which is claimed to be the most maneuverable airplane yet designed. The plane is a light bomber as well as a combat ship, since provision is made for carrying a 500-lb. bomb suspended between the wheels of the landing gear.

cables were known and thus the altitude of the planes. When the Wrights desired to know the altitude at which their planes were flying at the Belmont Park International Aviation Meet in 1910, they sighted the planes from the ground with a home made arrangement which operated on the principle of a known distance subtending an ever decreasing angle as it receded from the observer. They knew the span of the planes and could measure the angle subtended. Thus they determined the altitude of the planes long before they returned to the earth. The results obtained were surprisingly accurate.

String As Skid Indicator

Then again there came a period in flying when it was necessary for the pilot to know when his plane was skidding through the air. There was no known instrument developed which would give such indications. The Wrights adopted the simple expedient of tying a string to the front landing gear skid. When the plane flew straight or made a proper turn the string extended backward parallel to the skid. However, when the plane skidded through the air, the string inclined to the right or left of its regular position.

While many engineers realized the necessity for having airplane instruments, the early pilots would not accept the idea at all. They thought that the use of instruments would belittle them in the eyes of the flying world and tend to take away their prestige as aviators. Thus for quite some time the only instruments which the early pioneers would use were the recording barometer, necessary for securing authenticated altitude records; the aneroid which they used as a check against the barometer; the watch which indicated the time that they had been in the air and thus the amount of gasoline consumed.

The World War played a big part in the development and use of aircraft instruments. When a man's life is at stake, he will accept any kind of an attachment which even remotely assists him in getting back safe and sound. Thus one instrument after another was added until by the end of the war the cockpits of military airplanes were equipped with from 30 to 40 different kinds of instruments, controls, levers, switches and adjusting devices.

Generally speaking it may be said that the airplane instruments made their appearance in the following order: aneroid barometer, tachometer, airspeed indicator, compasses, and finally the many quantity and pressure gauges and engine thermometers.

Instruments Must Resist Shock

The altimeter was obtained by graduating the scale of the aneroid barometer in feet instead of pressure units and so modi-

fying the mechanism that the spacing of the graduations could be made uniform. Other instruments were adapted from the automotive and other industries with certain modifications to meet the rigid airplane requirements. Navigation instruments came into being when the lengths of flights made became too extended for the pilot to rely with any degree of success upon the inadequate maps available and his own bump of direction. Oxygen apparatus became essential when airplanes were developed which could attain altitudes above eighteen or twenty thousand feet. Thus, as in every other industry, necessity was the mother of invention and the accessories of aircraft were produced.

All aircraft instruments must be so designed and constructed that they can withstand shocks, vibration, tilting, acceleration, low temperatures, and reduced air pressures. The materials used in their construction must be such that the reliability of the instrument will not be affected by corrosion.

The weight of all instruments must be kept at a minimum for all types of aircraft. The size must be kept down on instruments to be installed in the limited space available in airplanes. It is always desirable to have the indicating scales of all instruments within view of the pilot.

Vertical Dials Save Space

Normally the indicating elements of all instruments are mounted on the instrument board in front of the pilot. As the space available is limited, every effort is made to so arrange the dials that all instruments will be within view of the pilot and he can read them with a minimum of effort. Thus it was that the vertical dial instrument was evolved. Formerly practically all instruments had circular dials, but as the number increased, in order to save space, the mechanism was so arranged that the indicator hand moved vertically. With this type of dial it was found that many additional instruments could be installed on the board.

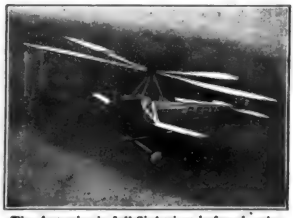
The vertical dial instruments have another advantage. The normal position of the indicating hands can all be placed along a horizontal line. Thus with a single glance of the eye, the pilot can see if everything is functioning properly. If one hand is above or below the general line, he need only to look at that particular hand.

Certain instruments can not be made up in the vertical dial type. These include the clock, compass and altimeter. Construction difficulties make the round dial necessary for these instruments. With all others, however, the vertical dial types have been found to be just as easy to construct, just as serviceable and practically as accurate as the round dial ones.

The instruments mounted on the modern airplane or airship are so varied and give such a wide scope of information that it is now possible for the pilots of aircraft to fly without view of the ground and still maintain their course.

Autogiro Plane With Free-Mounted Wind Vanes is Air Novelty

UNUSUAL in more ways than one is the photo of the Cierva Autogiro pictured here. It was taken from another airplane at a slightly higher altitude and shows the coast country of England below. What newspapers termed a "bad crash" was suffered some days later when the plane, which has the steepest angle of descent and slowest landing speed of any airplane in the world, struck soft going in a landing and nosed over. One wind vane broke. Since there is nothing sorrier looking than a crashed plane, the press men termed it a bad crash. The Autogiro's blades are mounted free. They rotate with the wind flow and are not powered.



The Autogiro in full flight just before leaving the British Isles.

RADIOVISION for All

by DON GLASSMAN

RADIO-MOVIES for everybody is the goal toward which T. Francis Jenkins, Washington Inventor, has been working. Mr. Glassman, author of this article, was present at the first demonstration of Mr. Jenkins' Radiovisor.

THE FIRST television broadcasting station, 3XK, Washington, D. C., operated three times weekly at 8 p. m. for the benefit of American Radio Relay League Members, recently began operation on the 4,900-5,000 kilocycle band.

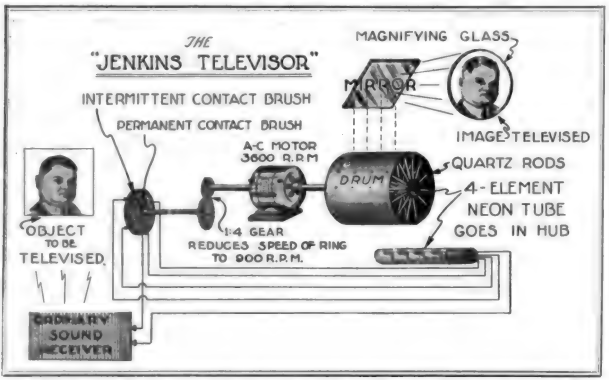
According to T. Francis Jenkins, builder and operator of the station, members have reported receiving his radiomovies from points all over the Middle West, as distant as Iowa.

Radiomovies may be received over a simple standard four-tube receiver, which can be built easily by any amateur, along with the recently perfected "Jenkins Radiovisor" which the inventor has just thrown on the open market.

The "Jenkins Radiovisor" is the first device of its kind to be supplied to the general public. In its cabinet form, the receiver is not a far cry from the ordinary sound receiver, and the two instruments must be linked in circuit if the radioist wishes to see as well as hear.

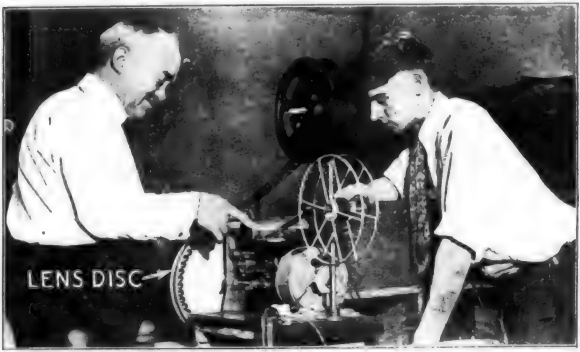
The televisor is marked by its simplicity and is different from any similar apparatus ever designed. Its construction makes possible rapid, quantity production. The principal parts are a scanning drum, a. c. motor, four-segment ring, a four-target neon tube, and a reflecting mirror.

The most important part, however, is the ingenious scanning drum. It consists of two hollow cylinders, the larger about 7 inches in diameter, and the smaller just large enough to accommodate a four-ele-



This is a schematic diagram showing the functions of the various parts of the Jenkins Radiovision device which T. Francis Jenkins, Washington inventor, has recently placed on the market.

Francis Jenkins Demonstrates His Low Priced Television Receiver



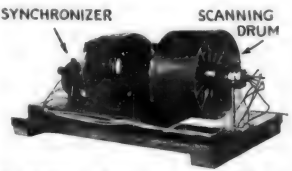
T. Francis Jenkins, of Washington, D. C., whose station 3XK recently began the broadcasting of radio movies three times a week. Jenkins is here shown with a portion of the transmitting set.

ment neon tube. The small cylinder is really the hub to the larger, and the connecting spokes are solid quartz rods which connect tiny holes in the rim and the hub. There are 48 such rods and they serve to transmit rays of light through an aperture in the wooden cabinet and onto the overhead reflecting mirror.

The special neon tube has targets about one-quarter of an inch square, as well as a common element which runs parallel to the inclosing glass wall. Each of these targets supplies the pulsating light flashes to corresponding series of apertures in the drum, which rotates on a direct shaft from the motor at 3,600 r. p. m.

The other side of the motor attaches to a gear which reduces the speed of the connecting shaft to one-fourth that of the drum, or 900 r. p. m. At this end of the shaft is the brush-contact disc found on other television receivers. The function of this brush is to rotate in step with a scanning disc at the transmitting end. It connects the circuit, one after the other, through four wires which attach themselves to the four targets in the neon tube. The brush disc has four segments and is in contact with two brushes. One brush keeps continuous electrical contact, while the other completes the circuit intermittently.

The reflecting mirror is mounted at an angle of 45 degrees. The image is enlarged by an ordinary magnifying glass about 10 inches in diameter. The input posts of the radiovisor are connected to the last audio amplifier tube of a receiver.



The Jenkins radiovision receiver which can be hooked up to any receiving set and which costs but $135.

Conducted by CHARLES MAGEE ADAMS

CHARLES MAGEE ADAMS, who conducts this department every month, enjoys an enviable position among radio authorities of the country. He has followed the developments of his field since the early days of the radio, and his helpful hints in this department each month are designed to help the radio owner to get more efficient service out of his equipment.

Simple Method of Electrifying Battery Sets

WITH THE trend in receivers more and more toward operation from the lighting circuit, many owners of sets designed to be powered with batteries wish to avail themselves of the greater convenience afforded by the newer development in power supply.

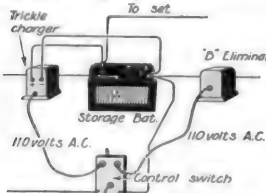


Figure 1

The following methods of electrifying a receiver are suggested. They require no change in the set, are simple and less expensive than conversion to a. c. tubes, yet give the convenience of electric operation.

The first method is recommended for those fans who have an A battery and trickle charger in good condition. The other equipment required is an A and B control switch, and a B eliminator of ample size to supply the set. The general connections are indicated in figure 1. (Detailed connections for the switch accompany the device.) It will be found more convenient to place the battery in the basement under the receiver, and the trickle charger as well, particularly if it be of the liquid type. Distilled water can then be added to both without fear of dripping acid on rugs.

With such an arrangement the B eliminator is automatically turned off and the battery put on charge when the set is not in use, and the charge stopped and the B eliminator switched on when the set is placed in operation, all by means of the filament switch on the receiver.

For those fans who have a heavy-duty charger rather than one of the trickle type, or who wish to be free from the necessity of checking the charge, an alternative arrangement is the use of a (Yaxley) full automatic control switch instead of the usual type. As well as switching the B unit and charger in and out as the set switch is manipulated, this device automatically stops the charge when the battery has become full, either with a heavy-duty or trickle charger.

If the fan has a heavy-duty charger, but his A battery has passed the prime of life, the arrangement shown in figure 2 is suggested. Besides the charger, this employs a B unit and an A filter. The latter, priced at about the same figure as a high-grade A battery, smooths out the ripple in the charger's current, giving as quiet and even power as that of a battery. Both dry and electrolytic types can be had, either satisfactory.

Attention is called to the fact that the power supply for the entire installation is controlled by means of a feed-through switch on the main a. c. cord. This should

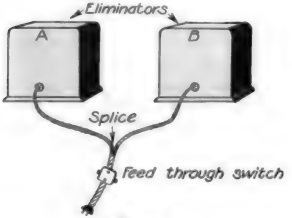


Figure 3

be used for turning the set on and off and the filament switch on the panel left turned on. If the latter is turned off while the power is on, damage to the B unit will result.

Also, the charger used must be of ample amperage to supply the set. If the charger is too small or worn out or the A battery available not in good condition and the fan wishes complete freedom from battery maintenance, the method shown in figure 3 is excellent. The A eliminator unit consists of a rectifier—like that of a charger—built into a filter. Several makes are available at prices about equal to the cost of a

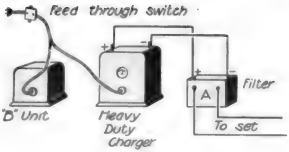


Fig. 2

battery and charger. As in the figure 2 arrangement, the feed-through switch should be used for turning the set on and off and the filament switch on the panel left turned on.

Also, in the cases of both figures 2 and 3, if the volume control on the receiver is of the filament rheostat type, the sort shown in figure 4 should be substituted. The variable non-inductive resistance of 500,000 ohms or more can be located anywhere convenient to the receiver, and after installation the filament rheostat should be turned to full and the variable resistance used to control volume. This arrangement is recommended because the use of the filament rheostat with the usual A eliminator tends to throw too high a voltage on other tubes in the set, shortening their life.

It is well to remember that both A and B eliminators should be installed in a manner that will permit the free circulation of air about them; this for cooling purposes.

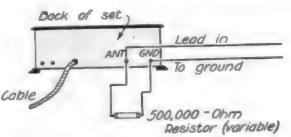


Fig. 4

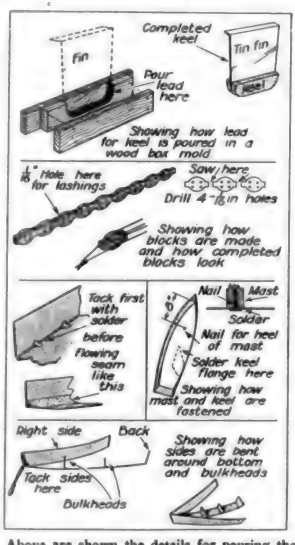
Listen in on Byrd! Charles Magee Adams has designed a radio hook-up on a short wave receiver which will intercept the messages Byrd will flash from the South Pole, whether they come from the base camp or from airplanes flying over the frozen land. Brush up on your dot-and-dash! Full details will appear in the February issue.

A Non-Sinkable SLOOP

by JAMES BATES

THIS MODEL sailboat is non-sinkable and is made from only five pieces of tin; four really, because the deck can be of wood if you like it that way. The spars are made from box wood and the sail is made from the cloth in an old sheet or flour sack. The little blocks are whittled from pieces of hardwood and the ropes are merely lengths of ordinary linen thread dyed brown with India Ink.

Take a piece of brown wrapping paper and lay out the boat substantially as shown in the drawings; that is, make the drawing full size for the bottom piece, then the full size drawing for the two side pieces, the back end, and so on. When the drawings full size have been made transfer them to stiff cardboard templates. These templates are merely pieces of stiff cardboard which are used to mark out around the tin. They serve as patterns. Build the boat up in cardboard first so as to be sure the edges come together properly and do not show a weavy line where they join. Then take the cardboard patterns apart and mark out the 20 gauge tin plate. This should be of the galvanized kind which can be found in any tin shop where furnace work is done. It is about the same heft as the tin used in furnace stovepipes and flues. It solders easily and can be bent nicely to shape. A heavier gauge will not shape well into the curves shown in the drawings, and a lighter gauge will surely buckle, so use 20 gauge.

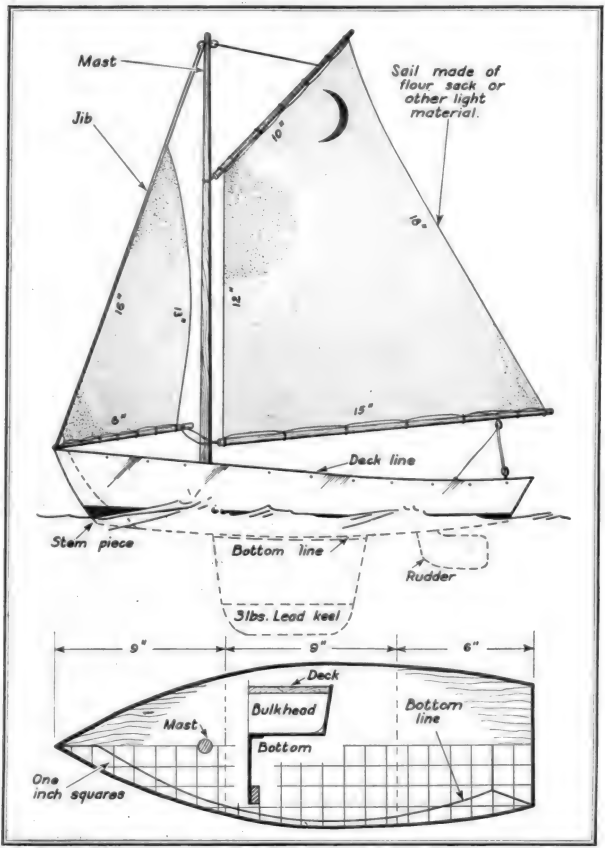


Above are shown the details for pouring the three-pound lead keel, making the little blocks and fills, and soldering the side seams.

When you have the bow pieces and the stations or mold sections made and soldered exactly in place on the bottom the sides of the boat may be put on. First, though, solder the sections or bulkheads to the bottom piece. See the flanges are neatly bent in a vise and that there are no dents. The solder should be sweated into the seam after it is tacked on each end and the bulkhead along the bottom will be tight as possible. The drawing shows how.

Then the sides are fastened. Begin at the bow and tack the starboard, or right, side on, then the left, or port, side at the stem piece. Then gradually work each back a little at a time so as to keep the tension on both sides of the molds even. This insures a fair hull when through with the soldering operation. Otherwise if the sides are bent around and soldered separately, the boat will have a lopsided shape. Just tack the sides with

Simple Sloop Rig Makes Model Easy to Build



Here is the rigging together with the half section plan showing how the non-sinkable sloop is soldered together and how the sails are bent on.

Easily Cast Lead Keel Gives Stability to This Tin and Wood Sailboat

a bead every two inches until they are bent. Then run the iron around the seam, running the solder into the fillet. Acid, muriatic acid, weakened with water, makes the best solder flux.

When the deck is put on, if it is wood or if it is tin, place a lump of sealing wax or paraffin about the size of an egg in each compartment. Then when the deck is on, hold the boat over a gas flame and run the melted wax into all the deck edge seams. The water cannot then enter the compartments and the boat can not be tipped over and sunk by a gust of wind.

The lead keel is cast in a wood mold as shown in the drawing. The tin is punctured and roughened with nail holes at the lower side of the fin, and the piece suspended perfectly square over the mold. Three pounds of lead will make the proper amount. The keel can be put on in two ways. It can be put on before the sides are, or it can be soldered on after. If put on before, it could be riveted and then the keel would never come off.

The spars are made from box wood and should be whittled according to dimensions shown. A nail is driven in the bottom of the boat at a point predetermined before the sides are mounted. There is a hole in the deck to accommodate the mast. The mast is driven down on the nail and the nail head is soldered to the bottom with a bead of solder.

Cleats are made from the heads of pins. The method of putting them in is shown. The blocks and they are made in this way: Take a piece of hard mahogany which you can get in any cabinet maker's shop or upholstery shop and whittle it to the shape shown. Then the holes are bored while the stick is solid. When the holes are bored the tabs are sawed off, and the blocks are ready for use. The rough edges will have to be whittled off but when sanded and filled with hot paraffin to make the surface smooth, the blocks will let the ropes slide through nicely. The rudder is made of a piece of flat tin soldered to the hull and bent according to the "drift" and "leeway" the boat would have.

The whole boat should be painted white, with black lampblack mixed in varnish below the water line. The spars should be orange shellacked and the whole boat is ready to use.

Experimenting with the trim is the best way to get results in sailing. The rudder will have to be set to counteract the way the sails make the boat drift, and when once the proper balance is found, the boat can be set on any one tack and will sail itself. A boat like this can be built for less than a dollar.

NEW TYPE OF SAIL REQUIRES SPECIAL RIGGING

EVERYWHERE in the world model making is gaining enormous popularity. England has for years been active in making miniature working replicas of ships and engines, and one of the reasons for the British national genius at machine design is found in the widespread hobby of model making.

German model enthusiast finds a new way for staying masts to be used with jib headed sails, which are the most efficient.

The photo at the left shows an aged German sailor with his wife who has evolved a new rigging for sailing sloops through the use of models. One may see the unique way of staying the tall masts used with the newer type of Marconi or Bermudian "gaff headed" rig. This type of sail is the most efficient aerodynamically which can be put on a sailboat, but because of difficulties met in securing spars strong enough, light enough and well guyed enough, it has only recently been adapted on larger vessels.

3rd Modern Mechanics MODEL CONTEST!

FIRST PRIZE, CUP AND.....$25
SECOND PRIZE $10
THIRD, FOURTH AND FIFTH PRIZES.... $5

YOU LADS who have built a model sailboat have here an opportunity to cash in on your labors! Send us a photo of your model, addressed to the Model Sailboat Contest, Modern Mechanics, Robbinsdale, Minn., so that it will arrive on or before February 1st, 1929, and a committee of judges will pass upon the merits of the model as depicted by the photo. *Do not send the model!* Recent contests have shown us it is wiser to ask contestants to submit photographs. The handling of models throws too much of a burden on our Editors. Here's the dope of this contest! Get goin'!

Some young yacht designer will win this handsome silver cup! See details.

1. Modern Mechanics will offer a first prize of $25 and a silver cup, a second prize of $10, and 3rd, 4th and 5th prizes of $5 each for the best photos of model sailing yachts which were built by Modern Mechanics readers. The photos must reach the Editorial offices of the magazine at Robbinsdale, Minn., on or before February, 1st, 1929 in order to be eligible.

2. Decision of the judges, Gene Deckert, the outboard motor racing expert, Philip L. Rhodes, Naval Architect, and Donald Cooley of Modern Mechanics Editorial Staff, will be final.

3. In case of a tie a duplicate cup and prizes will be awarded tying contestants.

4. Awards will be made on the basis of photographic excellence of the picture and on the apparent care with which the model is built as well as the age of the builder. Everyone stands an equal chance of winning.

5. The right is reserved to publish winning photos in Modern Mechanics.

6. Photos must be securely wrapped with postage included for return on a self-addressed envelope. Modern Mechanics assumes no liability for possible damage in transit, and will return promptly photos which do not win shortly after the close of the contest.

7. It is not necessary to be a subscriber to Modern Mechanics to enter the contest.

8. The contest is open to anyone except employees of Fawcett Publications, Inc., and their families.

9. Contest closes Feb. 1st, 1929.

So there you are fellows! Hop to it, and dig up the picture of that crack model sailer you built this fall. Everybody in on the fun, y'know, and by the way—the winners of the Model Airplane contest will be announced next month!

CONQUEST of

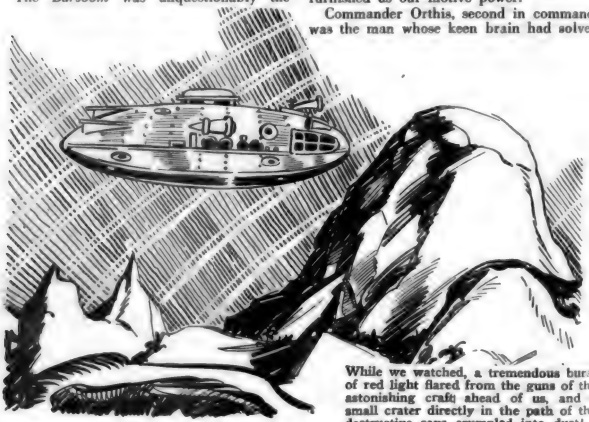
by EDGAR RICE BURROUGHS

THE FAMOUS author of "Tarzan" is at his best in this thrilling tale of strange adventure in the center of the Moon. The weird adventures that befall Julian and the Moon Princess in the astonishing Pillar City of Laythe constitute one of the most thrilling episodes of present-day fiction. Begin this serial now; a summary of previous chapters is printed as part of the story.

WHEN the interplanetary cruiser *Barsoom* was constructed in the year 2025, I was selected by the government as commander-in-chief of the expedition which sought to reach the planet Mars in the new ship. I am Julian, officer of the International Peace Fleet and narrator of this astonishing story of the almost unbelievable series of events that befell the adventurers who essayed this daring flight through space.

The *Barsoom* was unquestionably the most marvelous piece of machinery ever designed by man. In appearance it was somewhat similar to the antiquated Zeppelin type of airship which enjoyed considerable popularity a century ago. Instead of being covered with fabric, however, the *Barsoom* was fitted with a steel shell, insulated against the tremendous cold of interstellar space. It was shaped like a fat cigar and the outside was smooth metal except for the cockpit and the projecting Eighth Ray tubes which furnished us our motive power.

Commander Orthis, second in command, was the man whose keen brain had solved



While we watched, a tremendous burst of red light flared from the guns of the astonishing craft ahead of us, and a small crater directly in the path of the destructive rays crumpled into dust!

the MOON

Author of "TARZAN"

the mystery of the Eighth Rays and who had succeeded in harnessing them to supply power for the *Barsoom*. He had hated me bitterly since our cadet days, and the fact that I was appointed his superior intensified his dislike for me. However, he kept his resentment hidden under a mask of superficial respect, and for a time all went well with the five of us aboard the ship.

We left the earth on Christmas Eve, in 2025, and headed straight for Mars. The inside of the *Barsoom* was comfortably equipped with supplies to last us for five years in case we did not reach our destination as soon as we expected.

We were within a few thousand miles of

the Moon when Orthis ran amuck. He had broken into the lockers containing our supply of spirits, and the liquor sent him into a drunken frenzy. I had reprimanded him a short time before because of the laxity of his conduct, and his rage against me took a destructive form. He swung a hammer on the tanks containing our precious supply of the Eighth Ray, and we fell helplessly toward the pitted surface of the Moon!

We drifted through one of the craters of the Moon's crust and came to land in a queer country *inside* the satellite, where the fantastic purple vegetation and the weird mountain ranges impressed us with the fact that we were in an alien world indeed. There proved to be an atmosphere containing enough oxygen to sustain us. The five of us gave ourselves up for lost; under the circumstances, we took no measures to punish Orthis for his treachery, because we all felt that death was just around the corner.

One day I was out exploring the queer land, with Orthis as my companion, when we were startled to observe a herd of strange creatures thundering down on us. The animals appeared to be half horse, half man, but whatever species they may have belonged to, their attitude was unquestionably hostile. They carried short spears with which they menaced us. Our revolvers were soon emptied and we were taken captive by the creatures. They called themselves Va-gas, as we discovered when we learned their language.

For months we were held captive by the Va-gas. Orthis, for reasons of his own, made friends with Ga-va-go, the chieftain of the tribe. We were standing outside the Va-ga village one day when I observed a winged creature fluttering down towards us from the sky. To my amazement when it landed I found that it was a beautiful young woman. She, too, was made captive by the savage Va-gas, and when later I had a chance to talk with her I learned that she was Princess of Laythe, a country of the higher mountains of the Moon.

Arrived at Laythe

UNDER cover of a fierce lunar storm, I rescued the Princess Nah-ee-lah from the clutches of Orthis and we escaped from the Va-gas village. After many hours of wandering we came to a crater which Nah-ee-lah said was the entrance to the city of Laythe. We succeeded in lowering ourselves over the perilous brink to a tiny ledge fifty feet below, but the Princess soon discovered that the tunnel led to a Kalkar city, the Kalkars being a tribe who enslaved all strangers within their portals. Nah-ee-lah escaped from a group of Kalkars who pursued us, but I was taken prisoner.

I made friends with a Laythean named Moh-goh, whom the Kalkars held prisoner, and together we escaped from the city. We made our way to the mountains and had come into sight of the marvelous mile-high tower which was the city of Laythe when we became aware of a group of winged swordsmen swooping down on us. A score of winged arms crooked back their elbows, aiming their spears at me and Moh-goh. Helplessly we crouched there, waiting for the signal of death to issue from the lips of their leader.

But the signal did not come. With a despairing cry, Moh-goh had turned his face upward, and one of the winged men recognized him. We were saved! All that remained was for us to gain the crater which hid the tunnel leading to the city.

We came at length to the mouth of the crater, and here Moh-goh looped his rope about the base of a small tree growing close to the rim and slipped down to the opening of the tunnel directly beneath. I followed his example, and when I was beside him Moh-goh pulled the rope in, coiled it about his waist, and we set off along the passageway leading toward Laythe.

After my long series of adventures with unfriendly people in Va-nah, I had somewhat the sensation of one returning home after a long absence, for Moh-goh had assured me that the people of Laythe would receive me well and that I should be treated as a friend. He even assured me that he would procure for me a good berth in the service of Ko-tah. My greatest regret now was for Nah-ee-lah, and that she was not my companion, instead of Moh-goh. I was quite sure that she was lost, for had she escaped, falling back into the crater outside the Kalkar city, I doubted that she could successfully have found her way to Laythe. My heart had been heavy since we had been separated, and I had come to realize that the friendship of this little Moon

Maid had meant a great deal more to me than I had thought. I could scarcely think of her now without a lump coming into my throat, for it seemed cruel, indeed, that one so young and lovely should have met so untimely an end.

Inside the City

THE DISTANCE between the crater and the city of Laythe is not great and presently we came directly out upon the lower terrace within the city. This terrace is at the very rim of the crater around which Laythe is built. And here we ran directly into the arms of a force of about fifty warriors.

Moh-goh emerged from the tunnel with his spear grasped in both hands high above his head, the point toward the rear, and I likewise, since he had cautioned me to do so. So surprised were the warriors to see any creatures emerge from this tunnel which had so long been disused, that we were likely to have been slain before they realized that we had come before them with the signal of peace.

Following the excited glances of the Laytheans, I observed a tiny speck taking shape in the distant lunar sky. As it came closer, a shaft of light was reflected from its metallic sides, and I knew beyond doubt that the speck was the Barsoom—the ship that had carried us from earth!

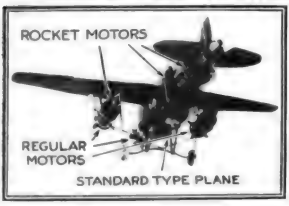
The guard that is maintained at the inner opening of the tunnel is considered by the Laytheans as more or less of an honorary assignment, the duties of which are performed perfunctorily.

"What do you here, Kalkars?" exclaimed the commander of the guard.

"We are not Kalkars," replied my companion. "I am Moh-goh the Paladar, and this is my friend. Can it be that you, Ko-vo the Kamadar, do not know me?"

a title which corresponds closely to that of the English Duke; and Moh-goh the Paladar, or Count. And so, to humor them, I told them that it meant the same as their Javadar or Prince. I was thereafter called sometimes Ju-lan-fit, and sometimes Ju-lan

ROCKET PLANE POWERED BY 86 GUN BARRELS



A STANDARD type plane which can be made into a rocket-propelled machine by equipping it with gun-barrel attachments is shown in the picture at the left. The machine is the invention of Maurice Poirier of Burbank, Cal. Regular gasoline motors are used in the plane in addition to the rockets. There are 86 gun barrels attached to the fuselage of the plane, and the concussion resulting from explosions in the tubes is expected to give the plane a speed of 400 miles an hour.

"Ah!" cried the commander of the guard, "it is, indeed, Moh-goh the Paladar. You have been given up as lost."

"I was lost, indeed, had it not been for this, my friend," replied Moh-goh, nodding his head in my direction. "I was captured by the Kalkars and incarcerated in City No. 337."

"You escaped from a Kalkar city?" exclaimed Ko-vo, in evident incredulity. "That is impossible. It never has been accomplished."

"But we did accomplish it," replied Moh-goh, "thanks to my friend here," and then he narrated briefly to Ko-vo the details of our escape.

"It scarce seems possible," commented the Laythean, when Moh-goh had completed his narrative, "and what may be the name of your friend, Moh-goh, and from what country did you say he came?"

"He calls himself Ju-lan-fit," replied Moh-goh, for that was as near as he could come to the pronunciation of my name. And so it was that as Ju-lan-fit I was known to the Laytheans as long as I remained among them. They thought that fifth, which they pronounced "fit," was a title similar to one of those which always followed the name of its possessor in Laythe, as Sagroth the Jemadar, or Emperor; Ko-vo the Kamadar, Javadar, as the spirit moved him who addressed me.

I Am Welcomed to Lathe

AT MOH-GOH'S suggestion, Ko-vo the Kamadar detailed a number of his men to accompany us to Moh-goh's dwelling, lest we have difficulty in passing through the city in our Kalkar garb.

As we had stood talking with Ko-vo, my eyes had been taking in the interior sights of this lunar city. The crater about which Laythe is built appeared to be between three and four miles in width, the buildings facing it and rising terrace upon terrace to a height of a mile at least, were much more elaborate of architecture and far richer in carving than those of the Kalkar City No. 337. The terraces were broad and well cultivated, and as we ascended toward Moh-goh's dwelling I saw that much pains had been taken to elaborately landscape many of them, there being pools and rivulets and waterfalls in numerous places. As in the Kalkar city, there were Va-gas fattening for food in little groups upon various terraces. They were sleek and fat and appeared contented, and I learned later that they were perfectly satisfied with their lot, having no more conception of the purpose for which they were bred or the fate that

awaited them than the beef cattle of Earth.

The U-gas of Laythe have induced this mental state in their Va-gas herds by a process of careful selection covering a period of ages, possibly, during which time they have conscientiously selected for breeding purposes the most stupid and unimaginative members of their herds.

At Moh-goh's dwelling we were warmly greeted by the members of his family—his father, mother and two sisters — all of whom, like the other Laytheans I had seen, were of striking appearance. The men were straight and handsome, the women physically perfect and of great beauty.

I could see in the affectionate greetings which they exchanged an indication of a family life and ties similar to those which are most common upon Earth, while their gracious and hospitable reception of me marked them as people of highly refined sensibilities. First of all they must hear Moh-goh's story, and then, after having congratulated us and praised us, they set about preparing baths and fresh apparel for us, in which they were assisted by a corps of servants, descendants, I was told, of the faithful servitors who had remained loyal to the noble classes and accompanied them in their exile.

with my relatively darker skin and my blond hair, I could never hope to be aught than an object of remark in any Laythean company. Owing to the color of my hair, some of them thought that I was a Kalkar, but upon this score my complexion set them right.

The Palace of Ko-tah

KO-TAH'S dwelling was, indeed, princely, stretching along a broad terrace for fully a quarter of a mile, with its two stories and its numerous towers and minarets. The entire face of the building was elaborately and beautifully carved, the decorations in their entirety recording pictographically the salient features of the lives of Ko-tah's ancestors.

Armed nobles stood on either side of the massive entrance way, and long before we reached this lunar prince I realized that possibly he was more difficult to approach than one of earthly origin, but at last we were ushered into his presence, and Moh-goh, with the utmost deference, presented me to Ko-tah the Javadar. Having assumed a princely title and princely raiment, I chose to assume princely prerogatives as well, believing that my position among the Laytheans would be better assured and all my interests furthered if they thought me

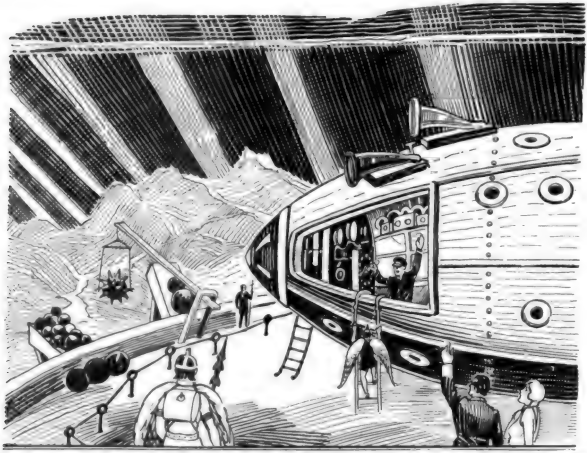
RADIO WAVES KEEP AIRSHIP ALOFT

PROPELLERS and engines are not needed to fly the model airship of Bernays Johnson, who is shown with his craft in the photograph at the right. A powerful radio wave which neutralizes the pull of gravity is the force which keeps the ship aloft. Johnson experimented for ten years before he succeeded in discovering the principle of his anti-gravity waves. The ship can be controlled from within itself or from the ground. It was exhibited at the recent Boston radio exposition.

We rested for a short time after our baths, and then Moh-goh announced that he must go before Ko-tah, to whom it was necessary that he report, and that he would take me with him. I was appareled now in raiment befitting my supposed rank and carried the weapons of a Laythean gentleman—a short lance, or javelin, a dagger and a sword, but

of royal blood, and so I acknowledged my introduction to Ko-tah as though we were equals and that he was being presented to me upon the same footing that I was being presented to him.

I found him, like all his fellows, a handsome man, but with a slightly sinister expression which I did not like. Possibly I



I left a few of the loyal palace guards to stand watch over the Barsoom, knowing that they would protect the ship from the curious throng eager to inspect the metal monster.

was prejudiced against him from what Nah-ee-lah had told me, but be that as it may, I conceived a dislike and distrust for him the moment that I laid eyes upon him, and I think, too, that he must have sensed my attitude, for, though he was outwardly gracious and courteous, I believe that Ko-tah the Javadar never liked me.

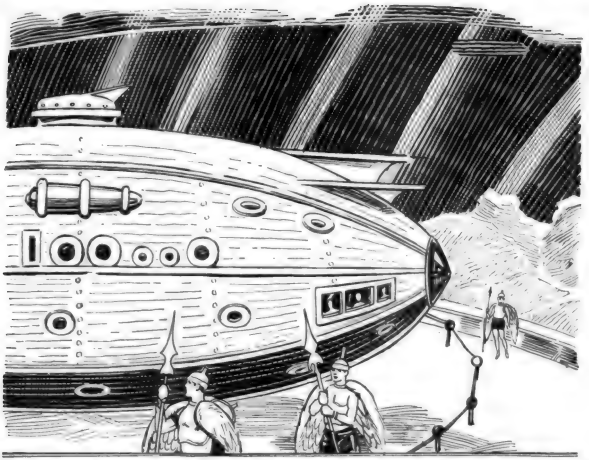
It is true that he insisted upon alloting me quarters within his palace and that he gave me service high among his followers, but I was at that time a novelty among them, and Ko-tah was not alone among the royalty who would have been glad to have entertained me and showered favors upon me, precisely as do Earth Men when a titled stranger, or famous man from another land, comes to their country.

Although I did not care for him, I was not loth to accept his hospitality, since I felt that because of my friendship for Nah-ee-lah I owed all my loyalty to Sagroth the Jemadar, and if by placing myself in the camp of the enemy I might serve the father of Nah-ee-lah, I was justified in so doing.

I found myself in a rather peculiar position in the palace of Ko-tah, since I was supposed to know little or nothing of internal condition in Laythe, and yet had learned from both Nah-ee-lah and Moh-goh a great deal concerning the intrigues and politics of this lunar city. For example, I was not supposed to know of the existence of Nah-ee-lah. Not even did Moh-goh know that I had heard of her; and so until her name was mentioned, I could ask no questions concerning her, though I was anxious indeed to discover if by any miracle of chance, she had returned in safety to Laythe.

In the Home of the Prince

KO-TAH held me in conversation for a considerable period of time, asking many questions concerning Earth and my voyage from that planet to the Moon. I knew that he was skeptical, and yet he was a man of such intelligence as to realize that there must be something in the Universe



Manned by my loyal comrades, the airship Barsoom offered a means of escape from the Moon for the Princess and Sagroth and myself—if only we could move before Ko-tah struck!

beyond his understanding or his knowledge. His eyes told him that I was not a native of Va-nah, and his ears must have corroborated the testimony of his eyes, for try as I would I never was able to master the Vanahan language so that I could pass for a native.

At the close of our interview Ko-tah announced that Moh-goh would also remain in quarters in the palace, suggesting that if it was agreeable to me, my companion should share my apartments with me.

"Nothing would give me greater pleasure, Ko-tah the Javadar," I said, "than to have my good friend, Moh-goh the Paladar, always with me."

"Excellent!" exclaimed Ko-tah. "You must both be fatigued. Go, therefore, to your apartments and rest. Presently I will repair to the palace of the Jemadar with my court, and you will be notified in sufficient time to prepare yourselves to accompany me."

The audience was at an end, and we were led by nobles of Ko-tah's palace to our apartments, which lay upon the second floor in pleasant rooms overlooking the terraces down to the brink of the great, yawning crater below.

Until I threw myself upon the soft mattress that served as a bed for me, I had not realized how physically exhausted I had been. Scarcely had I permitted myself to relax in the luxurious ease which precedes sleep ere I was plunged into profound slumber, which must have endured for a considerable time, since when I awoke I was completely refreshed. Moh-goh was already up and in the bath, a marble affair fed by a continuous supply of icy water which originated among the ice-clad peaks of the higher mountains behind Laythe. The bather had no soap, but used rough fibre gloves with which he rubbed the surface of his skin until it glowed. These baths rather took one's breath away, but amply repaid for the shock by the sensation of exhilara-

tion and well being which resulted from them.

In addition to private baths in each dwelling, each terrace supported a public bath, in which men, women and children disported themselves, recalling to my mind the ancient Roman baths which earthly history records.

The baths of the Jemadar which I was later to see in the palace of Sagroth were marvels of beauty and luxury. Here, when the Emperor entertains, his guests amuse themselves by swimming and diving, which, from what I have been able to judge, are the national sports of the Laytheans. The Kalkars care less for the water, while the Va-gas only enter it through necessity.

I followed Moh-goh in the bath, in which my first sensation was that I was freezing to death. While we were dressing a messenger from Ko-tah summoned us to his presence, with instructions that we were to be prepared to accompany him to the palace of Sagroth the Jemadar.

I Find the Princess

THE PALACE of the Emperor stands, a magnificent pile, upon the loftiest terrace of Laythe, extending completely around the enormous crater. There are but three avenues leading to it from the terraces below—three magnificent stairways, each of which may be closed by enormous gates of stone, apparently wrought from huge slabs and intricately chiselled into marvelous designs, so that at a distance they present the appearance of magnificent lacework. Each gate is guarded by a company of fifty warriors, their tunics bearing the imperial design in a large circle over the left breast.

The ceremony of our entrance to the imperial terrace was most gorgeous and impressive. Huge drums and trumpets blared forth a challenge as we reached the foot of the stairway which we were to ascend to the palace. High dignitaries in gorgeous trappings came down the steps to meet us, as if to formally examine the credentials of Ko-tah and give official sanction to his entrance. We were then conducted through the gateway across a broad terrace beautifully landscaped and ornamented by statuary that was most evidently the work of finished artists. These works of art comprised both life size and heroic figures of individuals and groups, and represented for the most part historic or legendary figures and events of the remote past, though there were also likenesses of all the rulers of Laythe, up to and including Sagroth the present Jemadar.

Upon entering the palace we were led to a banquet hall, where we were served with food, evidently purely in accordance with ancient court ceremonial, since there was little to eat and the guests barely tasted of that which was presented to them. This ceremony consumed but a few minutes of Earth time, following which we were conducted through spacious hallways to the throne room of the Jemadar, an apartment of great beauty and considerable size. Its decorations and lines were simple, almost to severity, yet suggesting regal dignity and magnificence. Upon a dias at the far end of the room were three thrones, that in the center being occupied by a man whom I knew at once to be Sagroth, while upon either side sat a woman.

Ko-tah advanced and made his obeisance before his ruler, and after the exchange of a few words between them Ko-tah returned and conducted me to the foot of Sagroth's throne.

I had been instructed that it was in accordance with court etiquette that I keep my eyes upon the ground until I had been presented and Sagroth had spoken to me, and that then I should be introduced to the Jemadav, or Empress, when I might raise my eyes to her, also, and afterward to the occupant of the third throne when I should be formally presented to her.

Sagroth spoke most graciously to me, and as I raised my eyes I saw before me a man of great size and evident strength of character. He was by far the most regal appearing individual my eyes had ever rested upon, while his low, well modulated, yet powerful voice accentuated the majesty of his mien. It was he who presented me to his Jemadav, whom I discovered to be a creature fully as regal in appearance as her imperial mate, and although doubtless well past middle age, still possessing remarkable beauty, in which was to be plainly noted Nah-ee-lah's resemblance to her mother.

Again I lowered my eyes as Sagroth presented me to the occupant of the third throne.

"The assassins of Ko-tah have come to slay you, Sagroth!" I cried. At that the Jemadar's swift sword leaped from its scabbard, and side by side we met the fierce attack of the enemy.

"Ju-lan the Javadar," he repeated the formal words of the presentation, "raise your eyes to the daughter of Laythe, Nah-ee-lah the Nonovar."

Intrigues of Ko-tah

AS MY eyes, filled doubtless with surprise and incredulity, shot to the face of Nah-ee-lah, I was almost upon the verge of an exclamation of the joy and happiness which I felt in seeing her again and in knowing that she was safely returned to her parents and her city once more. But as my eyes met hers the exuberance of my spirit was as effectively and quickly checked by her cold glance and haughty mien as if I had received a blow in the face.

There was no hint of recognition in Nah-ee-lah's expression. She nodded coldly in acknowledgment of the presentation and then let her eyes pass above my head toward the opposite end of the throne room. My pride was hurt, and I was angry, but I would not let her see how badly I was hurt. I have always prided myself upon my control, and so I know that then I hid my emotion and turned once more to Sagroth, as though I had received from his daughter the Nonovar precisely the favor that I had a right to expect. If the Jemadar had noticed aught peculiar in either Nah-ee-lah's manner or mine, he gave no hint of it. He spoke again graciously to me and then dismissed me, with the remark that we should meet again later.

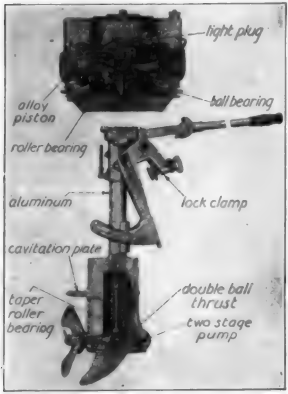
Having withdrawn from the throne room, Ko-tah informed me that following the audience I should have an opportunity to meet Sagroth less formally, since he had commanded that I remain in the palace as his guest during the meal which followed.

"It is a mark of distinction," said Ko-tah, "but remember, Ju-lan the Javadar, that you have accepted the friendship of Ko-tah and are his ally."

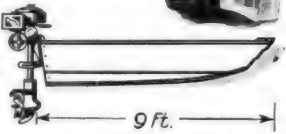
"Do not embroil me in the political intrigues of Laythe," I replied. "I am a stranger, with no interest in the internal affairs of your country, for the reason that I have no knowledge of them."

(Continued on page 176)

High Power Outboard Uses Ball Bearings



Above are pointed out many unusual features of the Evinrude 16 h. p. high speed portable outboard motor! To the right is shown the Truscott Speed Baby which travels at better than 35 miles an hour!



CLAMPED to the stern of a light scow-like boat, the engine shown in the cut to the left will travel at better than 35 miles an hour, it is claimed. When one considers that the length is but 9 feet, and the boat is not much larger than the man who pilots her, as shown by the photo, this speed is remarkable.

Liberal use of ball bearings is one of the many features incorporated in the clever design, which is a product of the Evinrude Motor Company, Milwaukee, Wis. Parts which would otherwise have high surface friction were it not for ball bearings enable this two cylinder, two cycle three port motor to develop over 16 h.p. It turns over at the rate of 4,500 revolutions per minute.

Among some of its unusual points of design, aside from the liberal use of ball and roller bearings, are a light in the timer handle fed with current from the magneto flywheel, a lock on a clamp screw which absolutely prevents theft, and a plate over the propeller which prevents cavitation. The engine weighs but 85 lbs.

The nine foot boat shown in the accompanying cut was built by the Truscott Boat Company, of St. Joseph, Mich., who have built many of these little speeders and have shipped them to all parts of the world.

TANDEM BIPLANE

INVENTED by a San Diego engineer, this tandem wing biplane has the second pair of wings mounted to the rear of the fuselage and slightly above the front pair. There are five motors, all accessible in flight.

The inventor of this tandem-wing biplane claims an increase rather than a decrease in efficiency, by placing the wings as shown.

NEW ATLANTIC LINERS

GERMAN shipbuilders are making a bold bid for the Atlantic passenger trade. They have just launched two 46,000 liners which are designed to give a speed of 26½ knots. One of these is the "Europa" launched at Hamburg, by the United States Ambassador, Mr. J. G. Schurman, and the other is the "Bremen," a sister ship, launched within 24 hours of the "Europa" at Bremen, the naming ceremony being performed by President von Hindenburg.

Newsboys Replaced by Silent Mechanical Salesmen

—Keystone.

A BERLIN newspaper has installed street vending machines which are the ultimate in mechanical courtesy. Dropping a coin in the slot, a newspaper is delivered at the bottom of the machine, and at the same time a phonograph record is released which rewards the purchaser with a politely spoken "thank you."

The automatic newsboy is given credit for boosting the street circulation of the paper that installed it. A copy of the edition is displayed in the front of the machine so that passers-by may read the headlines, thus doing away with the noisy sales-cry of the streethawkers. The machine is soon expected to make its advent in America.

SILENT PHONOGRAPH FOR RECORD TESTING

NEW YORK department stores have installed a number of silent phonographs in their record departments so that as many as a dozen customers can listen to different records while standing side by side at the counter, yet none of them hears the records being played on his neighbor's silent phonograph. This device may eventually do away with private rooms in which to try out records, for the expense is considerably less.

This silent phonograph looks like any other phonograph except that it has no box or case and it is installed back of the counter, sometimes alongside as many as eleven others of its kind. When a customer desires to hear a record, the clerk places it on the phonograph, and gives the customer a receiver. All the sound from the record passes through this receiver, for the phonograph has no other outlet. Eventually these silent phonographs may be adapted to home use,

NEW MOTOR GIVES 100 MILES TO GALLON

ONE hundred miles to the gallon of gasoline is the promise held out to aviators by Harry A. Palmer, Boston inventor, who is shown standing beside the model of his new motor.

The engine is of a simplified air-cooled type designed to eliminate valves and connecting rods, thereby doing away with several troublesome features of conventional motors.

In recent tests it turned over a full size airplane propeller at the rate of 1,100 revolutions per minute. One gallon of gasoline will keep the engine running for two hours.

In addition to its fuel economy, the unusually light weight of the motor is expected to appeal to airplane builders interested in keeping the "dead weight" of their ships down to a minimum.

—Keystone.

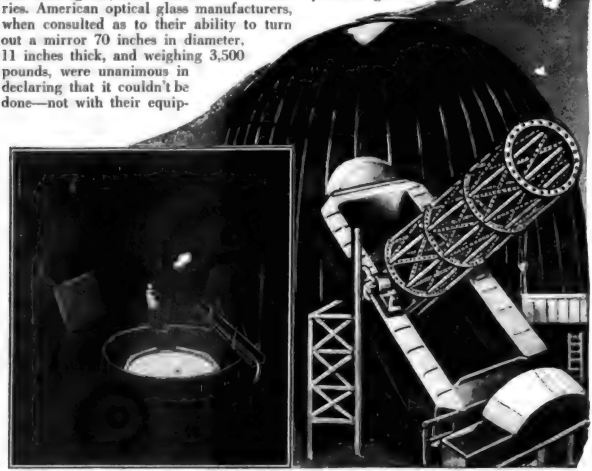
Huge Telescope LENS

WITH the consensus of opinion among American glass manufacturers being "It can't be done," Uncle Sam stepped in and produced a perfect 70-inch reflecting lens for the giant telescope at Perkins Observatory—the first time such a large lens has been successfully made in America!

ONE THOUSAND pounds of broken optical glass, retrieved from thousands of shattered spectacle, microscope and opera glass lenses, was used in making the largest reflecting telescope mirror of American manufacture—the 70-inch lens for the great telescope in the Perkins Observatory in Ohio Wesleyan University.

Such a large lens has never before been made in America, and only two of equal or larger size have been produced in the European glass making centers, where telescope lens making has been a fine art for centuries. American optical glass manufacturers, when consulted as to their ability to turn out a mirror 70 inches in diameter, 11 inches thick, and weighing 3,500 pounds, were unanimous in declaring that it couldn't be done—not with their equipment. Yet in the bequest of Professor Hiram M. Perkins, who provided funds for establishing the observatory named after him, it was specifically provided that the telescope should be of All-American manufacture. The officials of the University were in a quandary, unable to place their order.

"Suppose some infinitesimal speck of foreign substance gets into the molten glass," objected one manufacturer. "S[illegible] a speck would develop radial cra[illegible]h would split the glass into fra[illegible]p-pose the glass is cooled [illegible]r



Molten glass for the 70-inch lens is shown above directly after it has been poured into the specially built mold. The furnace in which the glass was melted is in the background. ground.

Made from Broken Glass

lens would be ruined. We can't afford to guarantee production of such a mirror. The risks are too great."

Eventually the federal Department of Commerce learned of the University's dilemma and agreed to attempt what the glassmakers said was impossible. Uncle Sam is an old hand at optical glass manufacture; for the last 14 years all the lenses used in the Navy for range finders and other instruments has been made by the government.

In addition to the broken optical glass, 4,600 pounds of sand and chemicals were melted in a huge pot in a gas-fired furnace. The molten mass was stirred by hand for six hours. Then the pot was tapped and the glass flowed into a mold built expressly for the purpose. This mold was electrically heated to serve as an annealing furnace. When poured, the temperature of the glass was 2,400 degrees Fahrenheit. During the week after pouring the temperature was gradually reduced to 1,112 degrees. At that temperature the glass was rigid and yet sufficiently viscous to cool without cracking.

For the following month the disk was cooled at the rate of 4½ degrees a day. It was then annealed for six weeks at 860 degrees, and following that it was cooled for 4½ months.

An expert optician ground one surface of the disk to parabolic shape. Such a surface reflects parallel light rays to a focus. It was possible to grind the huge lens for only ten minutes a day. The abrasives produce so much heat that the lens would be ruined if operations were continued for a longer period.

The new production methods which made it possible to manufacture the lens were originated by J. Walter Drake, former assistant secretary of the Department of Commerce, Dr. S. W. Stratton, president of the Massachusetts Institute of Technology, and Prof. C. C. Crump of Ohio Wesleyan University.

The largest telescope in the world is the 100-inch reflector at Mt. Wilson, California. But astronomers are not satisfied with the capacity of even this giant instrument, and plans are now under way for the making of a 200-inch mirror which will be four times as powerful as the Mt. Wilson telescope. The new telescope when completed is expected to answer many questions that have puzzled astronomers.

This is how a bright spot in the sky looks through a 70-inch telescope. The nebulous mass in the foreground surrounds the bright star Merope, one of the Pleiades. Many astronomers support the theory that such nebulae represent stars in the making.

In the 200-inch lens, fused quartz will be used instead of glass. This material can be ground steadily day after day without the polishing instruments producing destructive heat. It would take three average sized men, placed head to toe, to stretch across the 200-inch mirror.

Fused quartz is a naturally pure silicate which is prepared by grinding the quartz to a powder. It is then melted, and like glass, is refined while hot. It takes enormous heat to accomplish the melting and great difficulty is encountered in obtaining crucibles to withstand the temperatures.

Huge Telescope LENS

WITH the consensus of opinion among American glass manufacturers being "It can't be done," Uncle Sam stepped in and produced a perfect 70-inch reflecting lens for the giant telescope at Perkins Observatory—the first time such a large lens has been successfully made in America!

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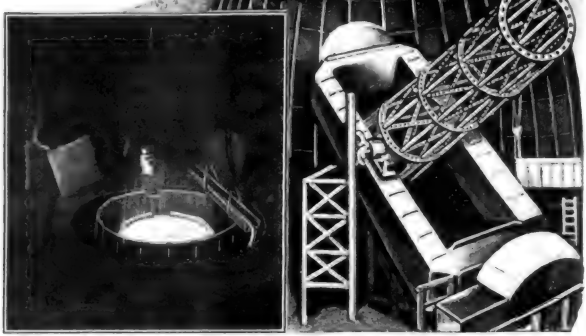

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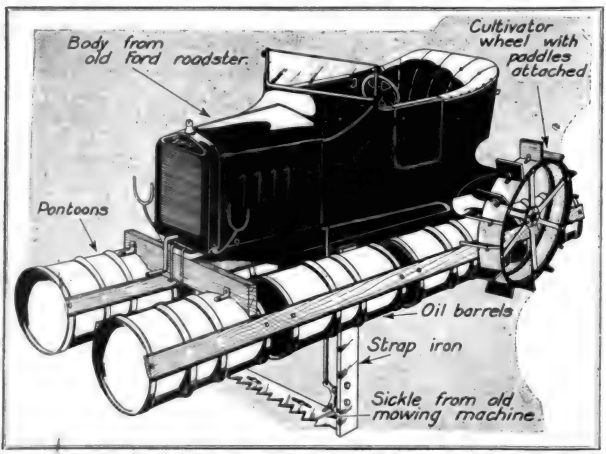
New USES for Old

MODERN MECHANICS will pay $10 for acceptable photos of every odd use to which old model T Fords have been put. The queer machines shown below are made from old "Tin Lizzies."

UP IN Minnesota where the water is sky blue many sportsmen sojourn during the summer. These same sportsmen use motorboats and demand clear, weedless lakes from their hotel and resort keepers. Further, so as to vex these resort operators, weeds have a habit of growing very thickly in certain lakes. One hotel keeper solved the problem with a weed cutter made from an old Ford. The machine is in daily use during the summertime near Melrose, Minn.

The drawing gives a very clear idea of how pontoons are made from old oil barrels, fastened together with carriage bolts to a long substantial plank, and how the old Ford roadster body is mounted on the "chassis."

The steering arrangement is particularly novel. The wheels which drive the boat are paddle wheels made from the rolling members of an old cultivator to which oak paddles are fastened by means of a series of strap iron angles. When the pilot of this



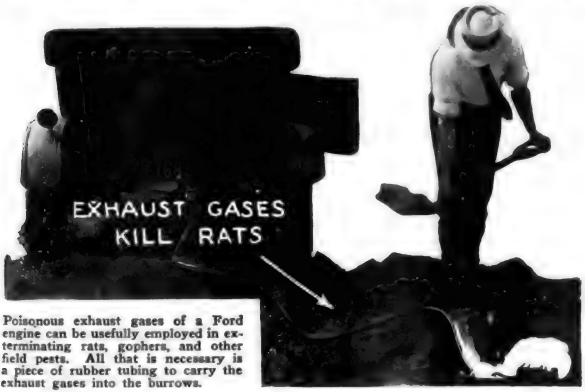
It's a rough night, mates, when this cornfield battlewagon swings into action! Here's a machine for cutting channels in weedy lakes. It is mounted on two pontoons built up of empty oil drums, driven by paddle wheels attached alongside the regular flivver wheels, and is steered like a caterpillar tractor.

Fords CONTEST!

queer cornfield schooner wishes to swing his craft to port or starboard he brakes the opposite wheel. This speeds up the other through the differential, and the craft laboriously makes its change of course.

Below, and driven from an eccentric welded to the propeller shaft is an extended cutter taken from an old mowing machine. This is supposed to wrestle the bulrushes into submission and clear a channel.

Rubber Tubing Attached to Ford Exhaust Exterminates Farm Pests



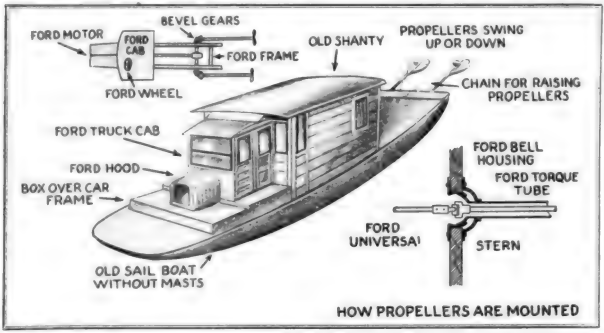
Poisonous exhaust gases of a Ford engine can be usefully employed in exterminating rats, gophers, and other field pests. All that is necessary is a piece of rubber tubing to carry the exhaust gases into the burrows.

EVEN an old Ford engine is plenty good enough for use as a rat exterminator. Maybe the motor has a bad piston slap, loose connecting rod, and badly worn bearings, but these little imperfections won't effect its efficiency a bit when it comes to poisoning prairie dogs, gophers, or other pests which annually cost the farmers of the country millions of dollars through their depredations.

Every automobile owner knows that carbon monoxide is one of the products of combustion in a gasoline engine, and he knows that it is a deadly poison. Carbon monoxide has taken the lives of many unwary motorists who ran their engines in an unventilated garage. An Iowa farmer, considering these facts, wondered why he couldn't use his old Ford to exterminate a large family of field rats which was making severe inroads into his crops.

He secured a length of rubber tubing, threw a shovel into the back seat of his car, and drove out to his field. It was easy enough discovering the entrance to the animals' burrows, and a simple task to attach one end of the tubing to the exhaust pipe of his car. The other end he inserted in the tunnel leading to the animal's under ground home. A shovelful of earth packed the tube into the opening so that it was air tight. Then he started his engine, let it run for a minute or two, and the deed was done.

This River Houseboat Made From an Old Ford is Hobo's Delight



A Ford light delivery truck is mounted so that the rear axle drives bevel geared propeller shafts. These shafts are hung on Ford bell housings using Ford universal joints, and can therefore be raised or lowered to accord to the depth of the water. The view at the left is an actual photo of the queer craft.

ON THE banks of the Mississippi at Wabasha, Minn., George McGinty has constructed an odd craft in which he cruises the length of the Mississippi River. The three elements which he used in building the odd craft, which is a most ingenious shallow draft twin screw boat, are: one Ford automobile intact, one old sailboat hull, and one summer cottage. Mounted like the pilot house of an old river stern wheeler, is the cab of a Ford light delivery truck. Behind this is the house which covers the living quarters of the eccentric McGinty, who whiles away his time puttering up and down the river with a self built radio control which he is fitting to his novel houseboat home.

The drawing shows the mechanical ingenuity of the use to which the old Ford power plant was put. The cab of the truck forms the pilot house of this odd craft. By simply stripping off the axle and the front wheels and the rear wheels and by mounting the chassis with the differential left on to drive twin screws, as shown in the drawing, the power plant of the boat was complete. The house was installed over the power plant, the deck covered in around this, and with the addition of bunks the queer craft was ready for the deep.

There is a rudder in the center between the two propellers, which are driven off the end of the Ford rear axle from bevel gears installed in place of the regular Ford wheels.

McGinty's whole boat cost but $173.40. The old Ford was picked up in the second hand man's yard, and like many another faithful old Ford car when a little useful work had been done on it, was ready for another million miles. The sailboat hull had lain in a boatbuilder's yard at the foot of Lake Pepin for many years, and with a coat of well tempered tar was made waterproof.

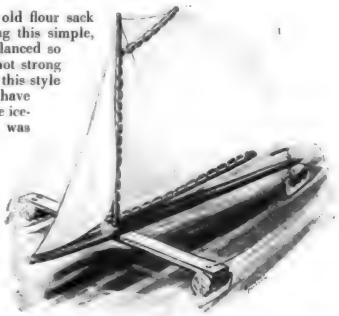
Plans for Making a Racing RAZOR BLADE ICEBOAT

By T. S. ASGAARD

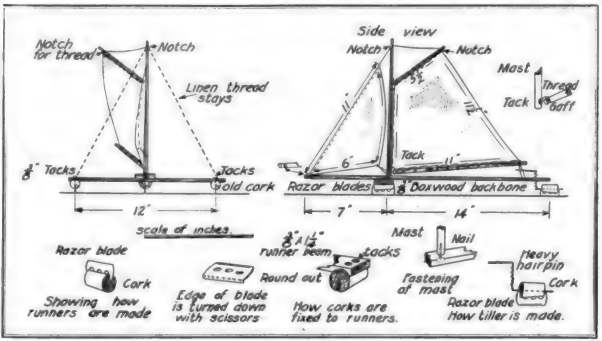
RAZOR blades, box wood, and an old flour sack are the materials used in building this simple, fast and sure sailing iceboat. Balanced so that she will sail herself in all winds not strong enough to tip her, it will be found that this style boat is the answer to those boys who have often tried to make a workable miniature iceboat, only to find that the balance was wrong, that the thing was too heavy, or that it would not steer.

You will not have such trouble with this design. The writer built her and knows what she'll do. And this is the exact design I used.

This is how Razola is built: take a piece of 3/8 in. box lumber of soft clear straight grain. Make one piece 5/8 in. wide and 3/8 in. thick for the backbone. Taper this for about 6 ins. from the front end so as to form a jib boom. This is the ice sailor's term for the spar which anchors the front sail, or jib.

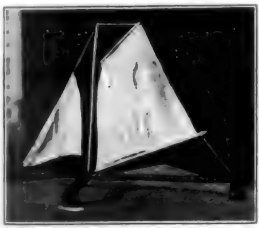


Whoopee! Here's a miniature iceboat made from five pieces of wood, three corks, three razor blades, a hairpin and some old cloth sacking. It can sail itself and go as fast as 18 miles an hour!



Follow the Above Dimensions Closely to Make Sure of Best Results

Another piece of the same thickness, but 1⅛ ins. wide is used for the runner beam. This runner beam is tapered from the backbone to each end as shown in the drawings so that the corks which form the anchorages for the razor blade runners can be tacked on later. The drawings make this all clear. Then the runner beam is fastened to the backbone with shingle nails such as can be found around any new house building, and these are bent over so as to firmly clinch the two pieces.



Mr. Asgaard's razor blade Iceboat "Razola" has furnished him much fun.

In the back end of the backbone a small hole is drilled for the heavy hairpin which holds the rudder blade. A knife slit will do for this, but as the hairpin is apt to joggle out in rough ice it is best to have a hole. The hairpin is put through the hole with no attempt to straighten out the humps. The humps furnish a sort of resistance brake for the rudder, holding it in whatever position it is placed. The cork for the rudder is slit for the razor blade, the hairpin is bent to be put in as shown in the drawing. Then the "sheet" is fixed. The back end of an iceboat is always termed the sheet end.

The runner beam ends are hollowed for receiving the corks. If they are not made to fit the round shape of the cork it will be hard to keep the corks nailed to the beam ends. The tendency will be for them to wiggle loose in any rough ice, and when once loose they will come off quickly. They are slit for the razor blades, which are put in at an angle as indicated on the drawings. In the boat I made and shown in the pictures here, I took the razor blades and held them slantwise across a scissors and rounded the fine cutting edge off. This makes a better ice boat, because the fine sharp blade usually is so sharp that unless the weather is very cold the blade will settle into the ice and freeze there. A blade with a scissors-rounded edge will be much faster and easier for the sails to move. It will do very little sidewise drifting.

The mast and the sail must be put on. The mast is a piece of box wood whittled to a round. Do a good job here, friends, because the shape of the mast just in front of the sail has a lot to do with the speed of an iceboat. See the drawings. If the mast is crookedly whittled the flow of wind onto the sail is interrupted and the sail will not be nearly so efficient. This has been learned from experiments conducted in Germany by those iceboat fans who have looked to airplane development so as to see what they could do by bettering the design of their iceboats. They found that a smooth spar in front of the sail makes all the difference between a winning speed and a speed which is just moving. The same holds true of the gaff and the boom. Whittle them to a nice round.

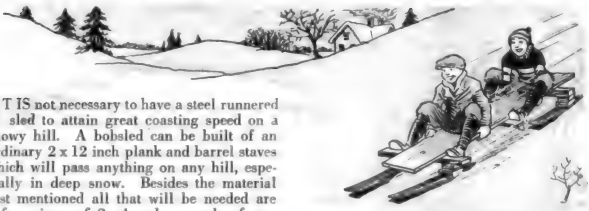
When these are cut to length, the sail is stitched on over hand with a sort of canoe stitch. The drawings explain. The sail is made of soft cotton cloth such as comes from flour sacks. The edge is laid with curvature in it so that when the wind bellies it it will be straight along the spar. About a ¼ inch curvature is right for each edge. Keep the up and down the mast side straight. It does not need a curve because the sail doesn't bend along the mast.

The gaff and the boom are bent onto the mast as shown. A tack is driven into the mast, stout linen thread is placed about it in lieu of a set of jaw fittings. The whole thing works well in the boat I built.

The guy wires are merely linen thread of the extra stout kind wrapped around the masthead, the end of the jib boom, and the runner beam ends. The mast is fastened with a long nail as shown in the drawing and will be easy to take down so that the whole sail can be wrapped up when the craft is being taken to the lake for a trial spin.

In sailing the boat, remember that an iceboat can go much faster than the wind which is pushing it. It slides across the ice at an angle to the wind.

Building a BARREL STAVE Bob



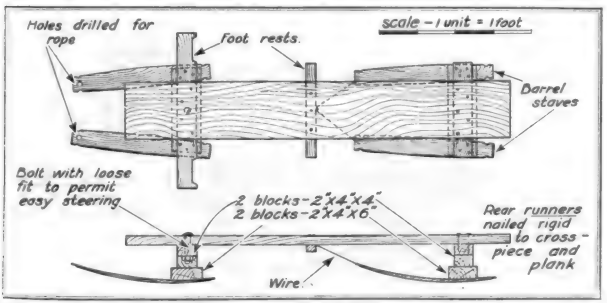
IT IS not necessary to have a steel runnered sled to attain great coasting speed on a snowy hill. A bobsled can be built of an ordinary 2 x 12 inch plank and barrel staves which will pass anything on any hill, especially in deep snow. Besides the material just mentioned all that will be needed are a few pieces of 2 x 4 and a couple of carriage bolts.

Saw a piece of 2 x 12 plank into a length of about 6 feet. If you cannot secure 2 x 12, two 2 x 8's laid side by side will do the trick nicely and make a good stout body for the runners.

Under the backbone of planks, cross members of 2 x 4's are placed and spiked thoroughly as shown in the accompanying illustration. Two tiers of the two by fours will be required to lift the bob far enough above the ground to give good snow clearance. On the front cross beam the lower 2 x 4 is separated from the upper by a few washers, and is pivoted on a good ½ in. carriage bolt so that the runners will be able to turn when they are put on.

Under the 2 x 4 cross members, fasten with spikes a piece of 2 x 8 plank. This is the final thickness of the cross members and is wider than the rest so that the runners will have bearing forwards and backwards. Saw out between the runners, which are of ordinary barrel staves, and the sled will be ready for use. A good scheme for finishing the sled to make it weather and ice proof is to paint it with boiled linseed oil, wiping the surplus off. The sled is then ready for use.

The boiled oil, if generously applied to the runners, will make them especially tough and will most certainly increase the speed of the sled, as snow is wont to gather on the runners in weather which is this sled's special forte; namely, light snows freshly fallen—just when the coasting fun is keenest!



The bobsled shown here, built of ordinary lumber and barrel staves, can outspeed the fleetest of steel runnered bobsleds in freshly fallen snow. Note the arrangement for steering the sled by pivoting the forward runners on a large carriage bolt.

Conducted by A. NEELY HALL
Author of "The Handy Boy," "Outdoor Boy Craftsman," etc.

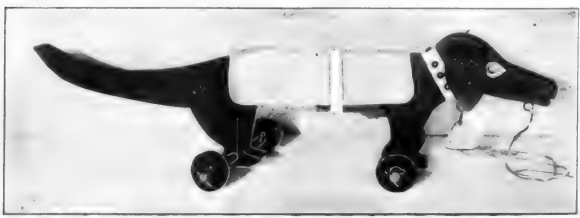
Winter is here! Mr. Hall recognizes the season in his department this month with a fine article on how to build an iceboat that will give you hours of thrilling sport. There are also complete directions for making a toy pup that will delight your younger brother or sister.

A Home-Made Animated Toy Pup

NOT a toy upon your Christmas tree will cause more fun than the toy dachshund pup shown in the accompanying photograph. He wriggles and wriggles, head, tail and body, as he runs along the floor, presenting a laughable and remarkably lifelike appearance. Make the pup for your younger brother or sister, if you like, but all of the family will play with him, and claim part ownership.

This is one of the simplest of mechanical toys to make. Just a loosely jointed body with feet mounted upon axles somewhat smaller than the holes in the wheels. That is the way the toy is built, and the working principle is that of wheels that do not track. Each pair runs at a tangent to the other, made possible by the large holes and small axles.

You can saw the toy out of any easily



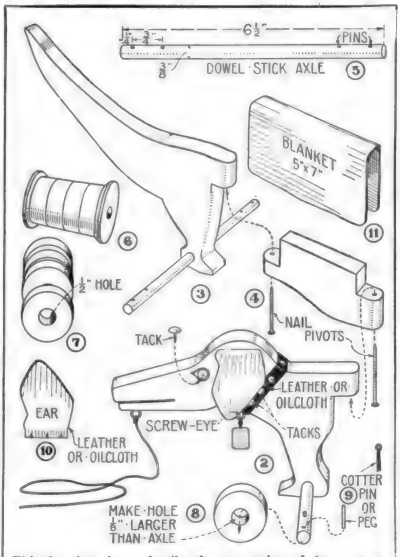
Here's the toy Dachshund completely equipped, even to the license plate under his collar. His erratic actions when pulled along by his leash will make him a favorite with the whole family.

worked wood ¾-inch thick. There are three parts to cut, and a pattern for them is shown on page 148. This pattern has been marked off into squares to simplify enlarging. The first thing to do in enlarging it is to draw upon wrapping paper twelve horizontal lines spaced ½ inch apart, then forty-eight vertical lines across the twelve horizontal lines, with the same spacing. The lines will give you a set of full-size squares similar to the diagram. Locate upon the large squares each curve and each straight line exactly as it is shown upon the small squares. By counting the lines up and down and from side to side, it will be easy to locate lines. When you have reproduced the pattern, check up to make certain that the lines are correctly drawn. Then cut out full-sized patterns, and use them to mark out your working material.

It may occur to you to design a pattern of your own. Well and good, if you keep one point in mind. There must be sufficient wood back of the rear wheels to give the weight necessary to throw the wheels out of alignment. Lacking weight, the rear wheels will very nearly track with the front pair.

Before sawing out the parts, bore the wheel axle holes. Then there will be less danger of splitting the wood. Make the holes ⅜-inch in diameter.

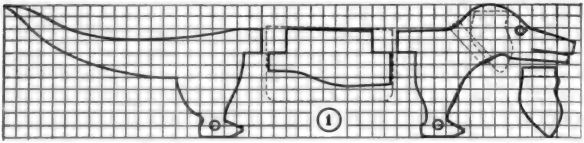
A coping saw is just the tool for cutting the parts, unless you own a motor driven jig-saw or band-saw. With the parts cut, trim up their edges, using a chisel or file for inside curves, and a plane or file for outside curves. The ends of parts to be jointed must be rounded as shown in Figs. 2 and 4 of the detail diagrams. Round them with a plane, chisel or file. Smooth all surfaces with sandpaper when the shaping has been completed, and rub off the sharp edges.



This drawing shows details of construction of the toy pup. Note that the ears are made of leather, the body of ordinary board, and the wheels and axles of materials readily found.

Drill a 3-16-inch hole through each of the body lugs (Fig. 4) to run the pivot nails through, and smaller holes in the head and tail lugs to drive the nails into (Figs. 2 and 3). Use a common nail 2 inches long for the front pivot, and a nail 1½ inches long for the rear pivot. The nails must be enough smaller than the larger holes to turn freely. Drive them carefully into the head and tail lugs, to prevent splitting.

Cut the wheel axles from ⅜-inch dowel-stick, or whittle them out of a square stick. Figure 5 shows the length, also the positions for pins for holding the wheels in place. Drill the holes with a ⅜-inch or 3-32-inch drill. Center the axles in the holes bored for them, and fasten with brads.



This checkered background will show you the proportions to use in cutting out various sections of the pup.

Spool Furnishes Wheels

It will be simpler to cut up a large spool like that in Fig. 6, than to saw out wheels. Divide the spool, between flanges, into four equal parts, draw the lines around the spool, and then saw through on the lines. The spool holes must be enlarged to ½-inch (Fig. 7.). Use a rattail file, working it evenly so as not to make the holes lopsided. Finish the wheels with sandpaper. Use cotter pins or wooden pegs (Fig. 9) for fastening the wheels upon the axle.

Knock down the parts, except the axles, for finishing. You will have no difficulty in applying quick-drying lacquer because surfaces are small. But enamel or oil paint will do if lacquer isn't available. Make the body brown. A little black added to vermilion produces a good brown. Make the wheels red, the axles yellow. Two or three coats will be required.

Make the pup's ears of black shoe-leather or oilcloth. A pattern is given in Fig. 1. One-quarter inch of material is provided at the top to turn under and tack to the head.

Tacks for Eyes

Use round-headed tacks for the eye pupils (Fig. 2), and paint the whites, or fasten pumpkin-seed shaped pieces of white cloth or oilcloth beneath the tack heads.

Make a collar of a strip of leather or oilcloth, and fasten it with a row of brass-headed tacks. Cut a blanket out of red flannel, of the dimensions given in Fig. 11, tack it to the body, and bind it with a strap of leather or oilcloth fastened around the pup's belly.

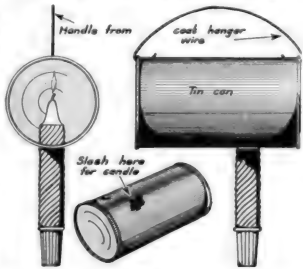
A screweye in the collar is the proper point to attach the leash and license tag, but the toy pulls better with the string tied to a screweye in the nose or below the lower lip.

MAKING A CAMP LAMP WITH CANDLE AND CAN

THIS season of the year, when nights are long and days are short, boys can find a hundred uses for a lantern that is simple to make and easy to handle.

Here's a lantern that is light as a feather, throws a good light, and costs little. It can be used to light your way about camp, or down the cellar steps, or even as a headlight for your pushmobiles.

While any tin can will do, a new one serves the purpose best because it will increase the light by the reflection of bright new tin. Toward the back of the can, punch a jagged hole, to fit whatever size candle you happen to find. As the candle burns, it is pushed further into the hole.



WINTER FUN with an ICEBOAT

Wherever this trim little iceboat appears, it is soon surrounded by an enthusiastic and envious crowd. The picture shows the iceboat just after it had defeated a dozen entries in a race.

Here are plans for an iceboat that will outspeed anything in its class. All that is required to construct it are a few pieces of lumber, two pairs of skate runners, and a canvas sail.

THIS yacht is too small to be classed as a speed boat, but it has speed in plenty for the beginner. Indeed, it proved the fastest craft of a dozen entries in a recent ice tournament of the West Parks, Chicago. You can enlarge its proportions if you want to.

There is little work to building this type of ice boat, and little material is required. Two-by-fours for the reach, runner beam, braces, rudder and runner blocks, 2-by-2's for mast, boom, gaff, tiller bar and foot bar, a board for a seat, two pairs of skates for runners, bolts, nails, mast rings, screw eyes, pulleys, number 8 cotton duck for the sail, and clothes line for halyard and sheet, will fill the bill.

Frame Is Sturdy

Figure 1 of the diagram is a plan of the frame. First, cut the reach and runner beam, then lap the reach 5 inches over the center of the edge of the runner beam, and bolt with two ⅜-inch by 7-inch carriage bolts. Make certain that these pieces cross at right angles before boring the bolt holes. Next, cut the diagonal braces, with their aft ends shaped to fit squarely against the reach, and their fore ends sawed off to come flush with the face of the runner beam. Bolt the braces, using a ⅜-inch bolt 10 inches long for the aft ends and four bolts 7 inches long for the fore ends. Make a seat of the size marked, of short pieces placed crosswise of the reach.

Cut the forward runner blocks of the length indicated, and bolt them to the under side of the runner beam. Build the rudder frame of two pieces of 2-by-4 with a 10-inch piece of 2-by-2 spiked across one end, and a 20-inch piece of 2-by-2 (the tiller bar) spiked across the other end (Fig. 2.). Spike a 2-by-4 block across the top of the frame, and bore a ½-inch hole through the center of the block to receive the rudder kingbolt. Bore a hole of the same diameter through the reach and seat (Fig. 1).

This Speedy Single-Passenger Iceboat Can be Built for Five Dollars

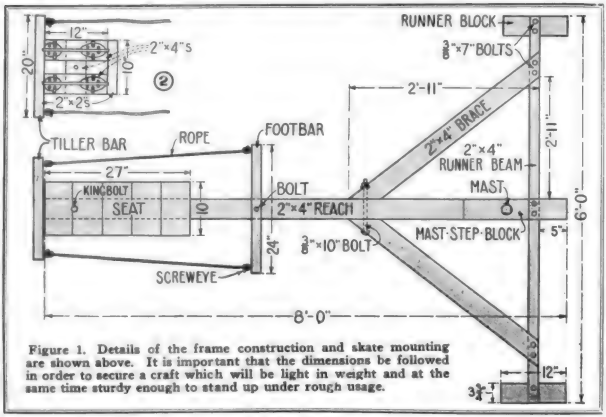


Figure 1. Details of the frame construction and skate mounting are shown above. It is important that the dimensions be followed in order to secure a craft which will be light in weight and at the same time sturdy enough to stand up under rough usage.

Mounting the Skates

In mounting the rudder, slip an iron washer over the kingbolt, to come between the seat and the bolt head, then slip on a large washer with a wide bearing surface, to come between the reach and rudder cross block, and insert a third washer between the cross block and the bolt nut.

Figure 2 shows how to screw hockey skates to the runner blocks. If you use clamp skates, cut away the sides of the runner blocks to admit the clamps.

Bolt the 2-by-2 tiller foot bar to the reach 38 inches from the stern. Screw a pair of screw eyes into it near its ends, and another pair of screw eyes into the tiller bar near its ends, and connect the eyes with rope or heavy jack chain.

The mast step requires two 2-by-4 blocks 12 inches long. Spike or bolt these to the reach, one to the under side, the other to the top (Fig. 1). Bore the mast hole through the top block and the reach. Make the hole 1¾ inches in diameter, and slant it so the mast will have a slight rake.

Shaping the spars out of 2-by-2's is not difficult, but it takes time, if one is particular about making them perfectly round, and getting a nice taper upon the mast. Start the shaping with a draw-knife or plane, and finish with a wood rasp and sandpaper.

Piping Makes Mast

A length of ¾-inch iron pipe may be substituted for the wooden mast, and two floor flanges may be used for the mast step. Bore a 1-inch mast hole through the reach, and screw one floor flange over the hole, and the other floor flange under the hole. Then have the pipe mast threaded for a length of 4 inches, and screw it into both floor flanges. Rug poles that are free from knots may be used for the boom and gaff. Figure 4 shows the loop end of the boom and gaff, and Figure 5 shows how to shape the loop out of a piece of strap iron. Nail and lash the straps in place.

If your hardware dealer cannot supply the mast rings, hunt up a blacksmith and have him make them. Get rings of large

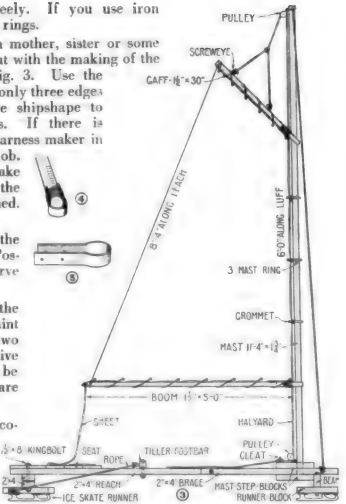
enough diameter so they will slide freely. If you use iron pipe, large key rings will do for mast rings.

Probably you will have to call upon mother, sister or some other sewing-machine pilot, to help out with the making of the sail. The dimensions are given in Fig. 3. Use the selvage of the cloth for one edge, then only three edges will require hemming. It will be more shipshape to have grommets set in for the lashings. If there is such a mechanic as a tent maker or a harness maker in your vicinity, call on him for this job. If grommets are not obtainable, make slits and have their edges stitched the same way that button holes are finished. Figure 3 shows the rigging.

A lateen sail may be substituted for the catboat rig. It is simpler to handle. Possibly you own a canoe sail that will serve the purpose.

Of course, you will want to finish the woodwork. Two coats of outdoor paint will do, but one coat of flat paint and two coats of automobile enamel will give more class to the job. The spars may be varnished with spar varnish if they are of clear enough stock to look well.

If you are somewhat of an artist, decorate the sail with a sketch of some sort, maybe a character from a popular cartoon. Then before you launch the craft lash a flag to her mast top. She will then be ready for the "glaze" as ice sailors term it, and should give you hours of great fun.



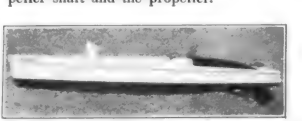
The method of rigging the sail is clearly shown in the above diagram. Don't forget to give the woodwork a coat of paint, linseed oil, or enamel.

This Simple Model Power Boat is Driven By Clockwork

DRIVEN by the works from an old mantelpiece clock the small boat shown in the photo is capable of a speed of three miles an hour, which it can sustain for five minutes at a time. It is the product of an English model maker whose enthusiasm for model boats caused him to build the model while he was convalescing from an accident.

Three feet and three inches long, it weighs ten pounds. The hull is painted white, the bottom a deep buff color, and the cockpit has genuine leather upholstery, real steering gear and a full set of miniature controls.

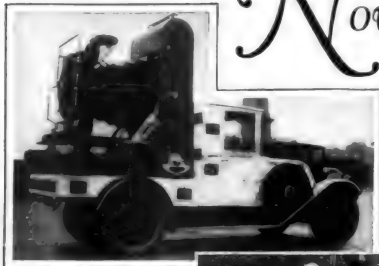
The clockwork was installed in the following manner. The balance wheel was removed, and two of the time gear train were taken out. To the end of one of the last gears was silver soldered a short spring. This in turn was connected with the propeller shaft and the propeller.



This meter long model was made by a convalescent Englishman who powered it with clockwork. It can go three miles per hour.

Novel Stunts of

IN these days of competition among advertisers it is the businessman using novel methods of attracting the attention of the buying public who is convinced that "it pays to advertise."



ABOVE—This wood and metal camera mounted on a motor truck advertises the business of a Paris photo-finisher as far as the eye can see it. Compartments are provided inside the camera for storing packages.

AT LEFT — Nippy the waitress stands day after day in the streets of London, holding a large package of tea in her hand—all in the interests of advertising! Nippy never gets tired of her job, for she is made of papier mache.

"Look at our legs," read the signs on the backs of these English girls—and as the picture shows, the men were glad to obey the order. The girls are advertising run-proof stockings—or, as the English express it, stockings that will never "ladder."

Advertisers

ONCE a manufacturer has made the name of his product a household word, his success is assured. A billion dollars will be spent this year on direct mail advertising alone.

AT RIGHT — This sign has "It"—known to the advertiser as attention value. The Indiana man who tacked this sign to a fence post succeeded in attracting attention and secured a job for himself and wife.

ABOVE — Billboards of the sky! Here is shown a floating ad for a German soap brand. The letters of the word are formed by captive balloons.

Sandwich men on wheels! The diminutive bicycle and single wheel attract the attention of the spectator, who pauses to read the message, strapped to the men's backs. All goes well unless the riders happen to take a spill—then the laugh is on the advertiser!

YOU CAN MAKE THIS MODEL ALUMINUM GAS ENGINE!

By ELMER WALL

Here is the first of a series on miniature engines which really run. This tiny gas engine can be built complete in YOUR workshop!

DESCRIBED here is an engine made almost entirely of aluminum. It was designed and built by the writer who is a mechanical engineer and experimenter. The bore and stroke is 1½ in., by 1¼ in. respectively, and it normally runs at a speed of about 2,000 R. P. M., ¼ H. P. being developed.

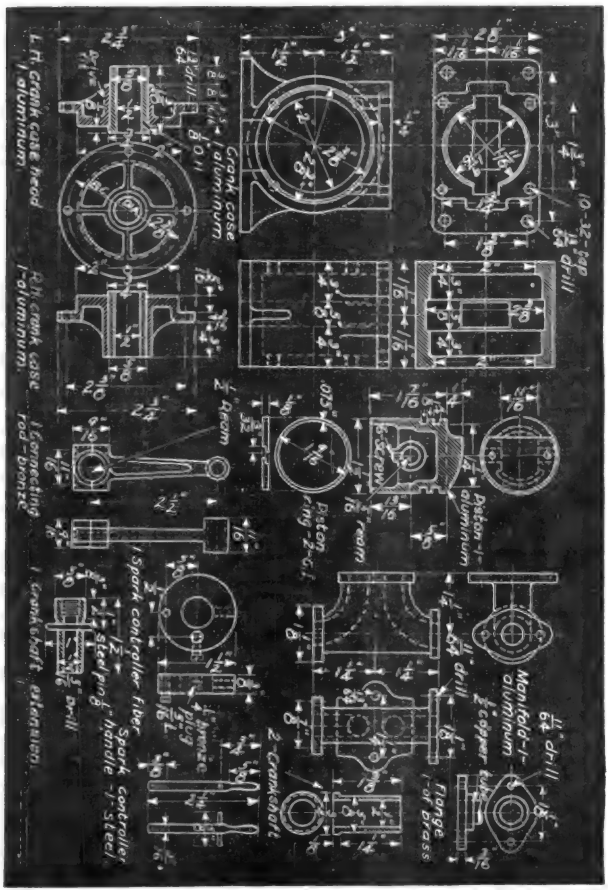
Only one piece of aluminum is required for the cylinder, and it is easy to machine, a chuck piece being cast integral with the top of cylinder for holding it in the lathe; it is later cut off. A steel sleeve is pressed into the cylinder, while heated for a liner. The cylinder is attached to the crank case by means of four studs and bolts passing through a flange cast onto the skirt of the cylinder. The cylinder is machined inside only, the cooling fins being left in the rough. The port holes are drilled and machined in both the sleeve and cylinder, before the sleeve is forced into the cylinder. Provision is made in the center of the cylinder to take an 18 m. m. spark plug which is counter-sunk into the head, making the plug look much smaller and giving it a neater appearance.

Mr. Wall's aluminum engine, 1½ in. stroke by 1¼ in. bore, is here shown ready to run.

Aluminum is used for the crank-case casting, which consists of three pieces, the main body and two end cover plates. To do an accurate machining job we lay out a center dummy and circle and face and then bore straight thru. A base is cast on the body of the case to form a bedding for the engine. This is machined and then turned around in the lathe and the top part is bored and faced, this forming the clearance necessary for the crank shaft.

The piston is also cast of aluminum and has a deflector head. Two piston rings are fitted on

This One-Cylinder Gas Engine Develops One-Quarter Horsepower!

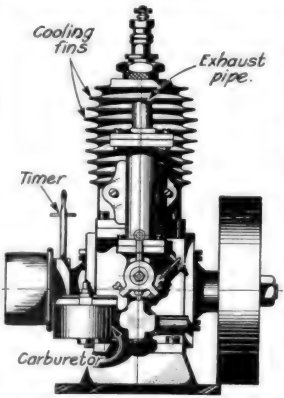

L.H. crank case head 1 aluminum
R.H. crank case 1-aluminum.
1 Connecting rod bronze
1 Crankshaft extension.
1 Spark controller fiber
Spark controller handle -1 steel
Crank case 1 aluminum
Piston ring -2-C.I.
Piston -1- aluminum
Manifold -1- aluminum
Flange 1 of brass
2 Crankshaft
10-32-tap
drill
Ream
Screw

Cylinder Assembly and Detail Drawings Showing Engine Dimensions

the piston to retain cylinder and crank-case compression.

A piece of solid bar steel is best for the crank shaft. It must be accurately turned and finished. The connecting rod is cast of phosphor-bronze, and after machining, both ends form their own bearings. The large end is split to allow for fitting the solid crank - shaft and the small end is reamed to 5-16 in. to make a good fit on the gudgeon pin.

The piston is assembled with the rod and inserted in its place in the cylinder. An opening on the bottom of the crank-case makes it easy to fit and assemble the crank - shaft. The crank-shaft projects at both sides of the crank - case, to one end of which is fitted the make and break device, which consists of a fibre disc with a brass inset, flush with its surface and a spring brush inserted in the driving pulley, which in turn has a heavy rim that may be drilled and tapped for a coupling flange to hold a propeller. To the other end is fitted the fly-wheel.



This assembly drawing shows the disposition of flywheel, timer, carburetor, and the double intake-exhaust manifold. The end plates on the crankcase, forming the bearings, are clearly shown. Countersinking makes the motorcycle size spark plug look smaller. Details on opposite page.

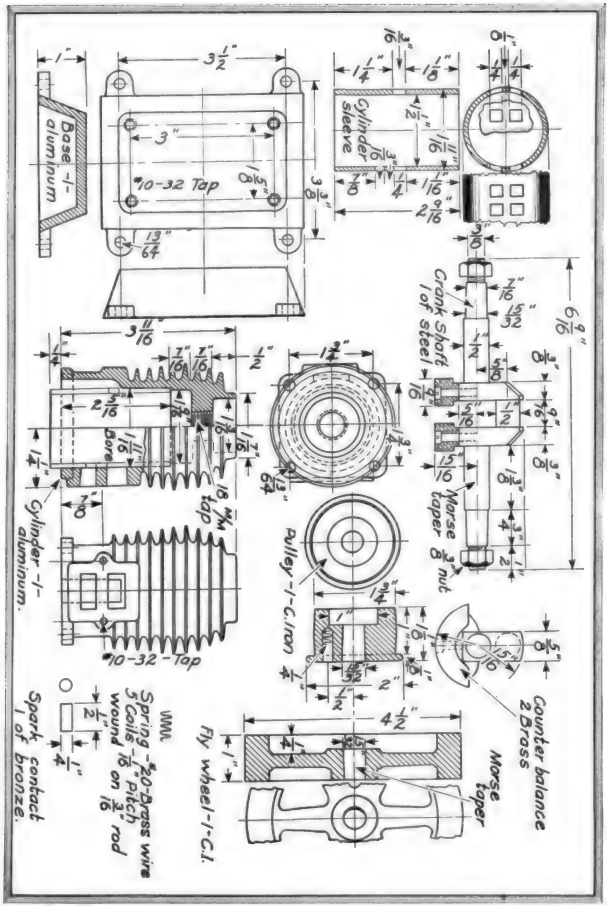
The carburetor is small and neat. It is made of brass and is of the float feed type, having the needle valve adjustment. A cork float is used, being heavily doped with celluloid varnish, and mounted on a German silver needle which seats direct in a coned seating in the gas supply union. The jet is inclined and is simply a hole drilled at an angle of about 45 degrees thru the choke tube into the float chamber.

The ignition system used consists of a simple trembler coil, such as used on the Ford and the simple make and break contact, described above, in conjunction with six volts of dry cell battery. We have found this method of ignition to be the most reliable and cheapest form attainable.

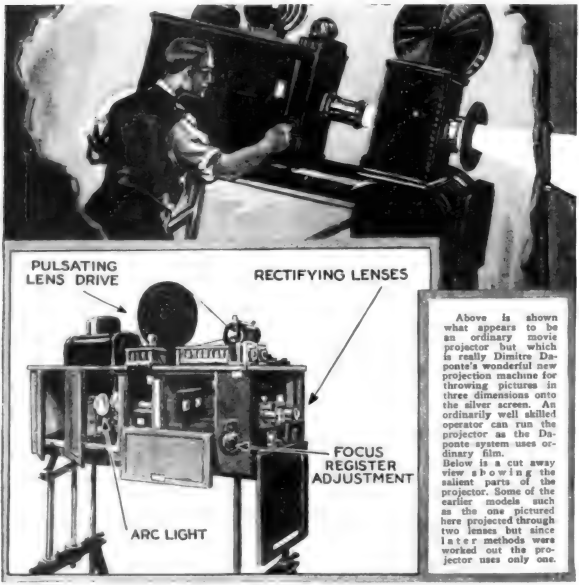
The system of lubrication used, is the simplest method in practice. It consists of a mixture of gasoline and oil and is very efficient when used in the type of engine illustrated in this article. The procedure and operation are as follows: — oil is mixed with gasoline in the proportion of 1 to 20. This mixture is then atomized by the carburetor and passes into the engine, where the oil vapor condenses on the moving parts. So long as the engine is running, automatic lubrication is in progress. This method is particularly applicable to this engine, a two stroke, as the incoming gas enters the crank-case first and deposits most of its oil on the parts which need it worse.

Aside from the engine the little carburetor is most worthy of description, but owing to the fact that it is a separate problem, requiring a separate description and set of drawings, it has been decided by the editors to hold the article on the building of the Wall engine carburetor until the February issue. Full details of the making of the float and the many minor carburetor parts will be covered, together with notes on how to machine it.

If it is desired, further information can be had from Mr. Wall at 5900 N. Fairfield Ave., Chicago, Ill.


Base -1- aluminum
#10-32 Tap
Cylinder sleeve
Crank Shaft 1 of steel
Morse taper
3/8" nut
Bore
18 M/M tap
Cylinder -1- aluminum.
#10-32 - Tap
Pulley -1- C.I. iron
Counter balance 2 Brass
Morse taper
Fly wheel -1- C.I.
Spring - #20 - Brass wire 5 Coils - 1/16" Pitch wound on 3/16" rod
Spark contact 1 of bronze.

Movies that Leap



Above is shown what appears to be an ordinary movie projector but which is really Dimitre Daponte's wonderful new projection machine for throwing pictures in three dimensions onto the silver screen. An ordinarily well skilled operator can run the projector as the Daponte system uses ordinary film. Below is a cut away view showing the salient parts of the projector. Some of the earlier models such as the one pictured here projected through two lenses but since later methods were worked out the projector uses only one.

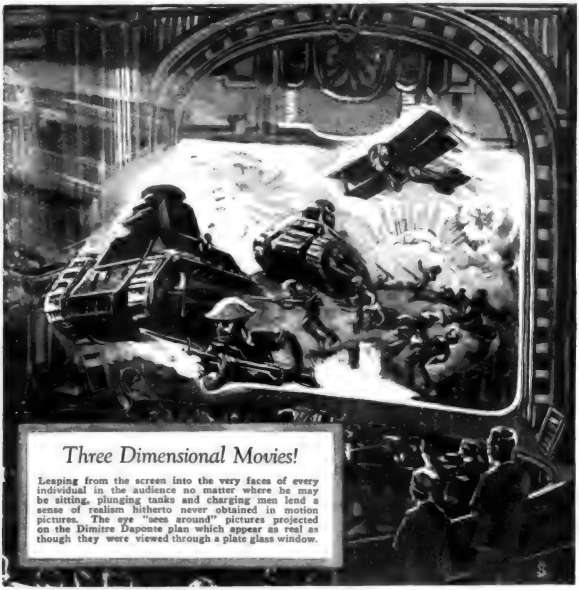
By WESTON FARMER

A POOR boy from Budapest, who in his early childhood learned about the functions of the human eye in his struggle against defective vision, has invented a system whereby stereoscopic movies may be projected upon the screen and viewed by the audience without the use of the usual visors and colored screens!

The man's name is Dimitre Daponte. In his early years he was troubled with faulty eyesight, and in studying the mechanics of the eye was intrigued with the phenomenon of sight known as "persistence of vision." This is the term physicists use in describing the ability of the eye to retain an impression after the scene has changed or after the eye has been closed to the view.

You can bring the truth of this to mind in recalling that after looking at the sun there will be a vivid impression of a ball of fire left on the retina of the eye by the light.

From the SCREEN!



Three Dimensional Movies!

Leaping from the screen into the very faces of every individual in the audience no matter where he may be sitting, plunging tanks and charging men lend a sense of realism hitherto never obtained in motion pictures. The eye "sees around" pictures projected on the Dimitre Daponte plan which appear as real as though they were viewed through a plate glass window.

In real life the eye sees *around* a thing, so to speak. One eye, being set a short distance from the other sees just enough different a view to let a sort of mental triangulation take place which enables the mind to estimate distance and depth. The reason that the third dimension or dimension of depth is left out when a picture is presented on the screen is that both eyes see exactly the same view.

M. Daponte reasoned that if a camera could be made which would take two views from two points no farther apart than the distance between one's eyes, and then reproject them so that each eye would recognize its own view, then blend them so that continuous motion could be imparted to the film, that a stereoscopic motion picture would result. He was right, and recent demonstrations in London have proved his claims to the letter.

The machine devised was a combination team of a camera and projector which would follow out M. Daponte's theory. He built a camera with two lenses spaced about two inches center to center and arranged

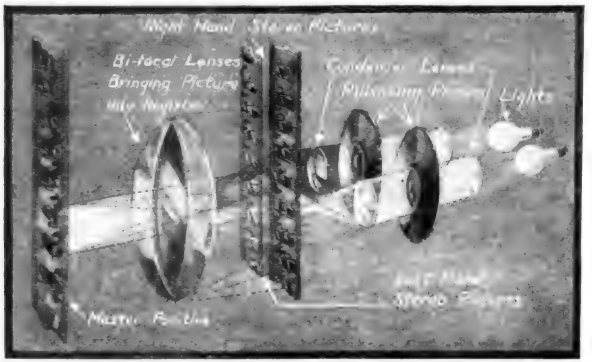
the shutters so that first one lens and then the other took pictures of the action. Only he speeded the film up to 32 feet a second so that ordinary 16 foot per second speed would result to the eye, since it was his plan to make each eye view only its own side of the picture.

The film resulting from such a camera you can visualize as you read this page by winking first one eye and then another in rapid succession at, say, a chair, noting the difference in view.

With the resulting two strips of film there remained the problem of putting them into one reel, so that the film could be run by the average operator in various theaters. Daponte devised a projection system which is fool proof, since the dissimilar views are finally printed on a master positive. Instead of being printed side by side and projected in superposed positions on the screen, which would result only in a blur, Daponte made use of the previously explained phenomenon of the persistence of vision. He ran this master film at double speed, threw one view after the other alternately on the screen so that the eye was actually fooled into thinking it was looking at the stirring events pictured before it as though they were real life.

The diagram at the bottom of the page shows how this was accomplished with two very clever lenses which shaded the light to achieve the desired stereoscopic results in the following manner:

Since the right eye focus is naturally on things with a left hand objective the left objective is quickly thrown on the screen. Then, since it is the tendency for the right eye to recognize the view quicker than the left, the left eye is greeted with a view from the right objective, cleverly and speedily blended by the pulsating lenses which fade one view into the other without any change whatever in the intensity of the light. Thus the right eye sees what it is trained to see, the left eye sees what it is trained to see, and from any portion of a motion picture house objects are made to plunge directly at the viewer, who, though he instinctively retreats, is only being fooled by a strip of film running in jerks through a projector possessing lenses which pulsate the light so as to blend one view into the other too quickly for clumsy, fallible human eyes to detect!



Here is the way in which the films that are shot at eye width are alternately printed on to a master positive. Two separate printing lights send a beam through the synchronised rotating lenses. The beam is condensed, passed through the negatives, rectified by bifocal lenses bring the views into register. The light is alternately pulsated from one view to the other so that no variation in intensity is noticeable. The resulting positive throws a stereoscopic picture.

"Frigidine" is New Beauty Treatment for Women

AS A MECHANICAL aid to beauty, the National Beauty and Barbers Supply Dealers Association introduced in a recent convention a new type of light treatment which emits a blue actinic light called "Frigidine."

At present it is estimated that American women pay $3,472 every second to heighten their beauty through the use of cosmetics and beauty treatments. This figures out at $55.30 a year per woman.

This light was devised as a substitute for astringent massages. "Frigidine" dries the tissue in the skin, removing it. This causes fresh skin growth to be stimulated and a beautiful complexion is the result. The woman in the photo is Miss Elaine Neilon, who is giving a demonstration of the new device.

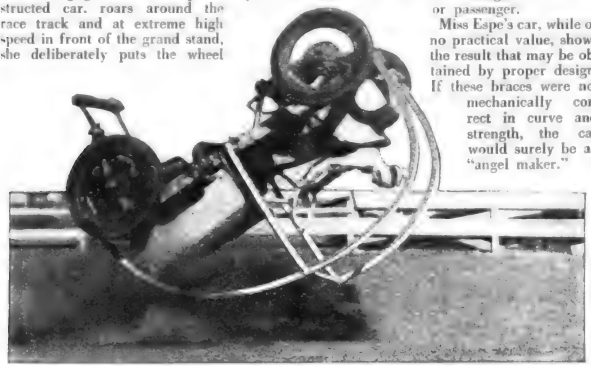
By using light emitted from a series of semi-circular tubes, women find this electrical device beneficial to beauty.

LADY DAREDEVIL DRIVER SAYS "LET 'ER BUCK!"

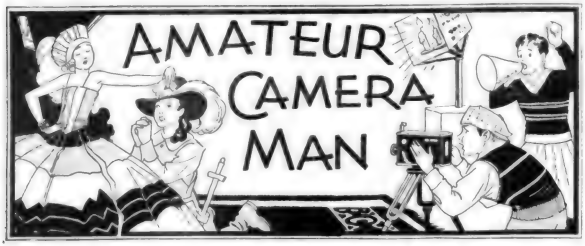
MISS NELL ESPE, daring woman race driver, recently furnished crowds at the Washington State Fair with a brand new kind of thrill when she inaugurated the stunt known as "turning turtle with Lizzie." The daring girl takes her peculiarly constructed car, roars around the race track and at extreme high speed in front of the grand stand, she deliberately puts the wheel hard over and catapaults into a series of somersaults.

The steel structure that guards Miss Espe while whirling around is designed so that the car can roll over and come up again on its wheels without damage to either car or passenger.

Miss Espe's car, while of no practical value, shows the result that may be obtained by proper design. If these braces were not mechanically correct in curve and strength, the car would surely be an "angel maker."



Here we see Miss Espe, daredevil race driver, in the process of a somersault. The cleverly constructed braces protect both car and driver from damage. The loops are designed so that the car can make a series of somersaults.



Conducted by WALTER D. KERST

Mr. Kerst's authoritative articles in this department every month describe methods used by professional cameramen in producing various screen effects, and show how these methods may be adapted to the use of the amateur. As an associate member of the Society of Motion Picture Engineers, Mr. Kerst is nationally known as an expert on the technical aspects of movie making.

Use These Masks to Get Real Professional Effects

"EFFECT" filters, or masks, as they are sometimes called, are used to secure many varied effects such as foggy weather scenes, scenes in which the picture is softly diffused, vignetted scenes where the picture appears as an oval or circle in the center of the screen, the edges blended softly all around into black, white or gray, and many others. Almost every professional movie production shows the use of effect filters and it would pay the amateur movie maker to study these effects for possible use in his own films.

The most common effect is that in which the edges of the screen picture are a diffused gray tone, the center being clear and sharply defined, or where the entire scene is diffused, much or little, depending on the type of mask or filter used. As a rule, these effects are obtained by the use of gauze masks placed in a mask box in front of the lens. The diffusing filters that can be purchased are of glass that is clouded to different depths, depending on the result

At the left is shown how the conical mask box described by Mr. Kerst is attached to the camera lens. Two types of masks are shown above. The one at the left, which is a solid piece of black cardboard with a saw-tooth edged oval opening, produces dark bordered vignettes. The one at the right is made from fine gauze which softens the edge of the picture.

How Movie Professionals Produce Vignette Shots With Gauze Masks

These two pictures show how professionals employ masks in gaining their effects. At the left is a straight shot; at the right is the same scene made with a vignetting mask. The scenes are from the production of "Madame Pompadour."

desired in the finished picture. These filters are slipped in a holder which fastens to the front of the lens, the holder being adjustable to different size lens barrels. The black gauze masks, however, can easily be made by the amateur.

To make such a mask, take a piece of black cardboard, about three or four inches square, and cut a square aperture from the center, leaving a frame border about a quarter of an inch wide. The exact size of the cardboard frame will depend on the distance it is to be placed in front of the lens; the further away the larger it should be so that all the rays of light passing to the lens will pass through the gauze. Cut a piece of very fine mesh black gauze the size of the cardboard and paste it on the black frame. This mask can then be inserted in a slot in a mask box affixed to the front of the lens, or it can be suspended in front of the lens by means of a thin rod fastened to the camera, extending out over the lens the desired distance.

Now make a second mask similar to the first, but exactly in the center cut a circular aperture. Since it is not possible to focus the image directly on the film in most amateur cameras, a series of actual shots must be made to determine the exact size of the circular aperture and also the distance it should be placed in front of the lens, so that it will properly frame the picture on the film and show the circular vignetting effect. Make several size masks as before, with circular apertures of different sizes, varying from one-eighth to one-half inch in diameter.

The camera, loaded with film, is placed on a table and a close-up of any object sighted in the finder. The mask with the smallest aperture is placed, for example, one inch in front of the lens, the mask being so placed that the center of the circular aperture is on a line directly with the center of the lens. Shoot a few feet of film, move the mask a *very* slight distance further from the lens, keeping it always on

QUESTIONS AND ANSWERS

Readers of this department are invited to submit their problems to the department editor. A self-addressed, stamped envelope should accompany all queries.

Q.—How can I avoid a white flash of the screen wherever I make a splice in my film?—C. B. J.

A.—You are scraping too much emulsion from your film. Hold the scraper absolutely perpendicular to the film surface and be sure that you have applied enough water or moisture to sufficiently soften the emulsion so that it will leave a clean straight edge where it is scraped away.

a direct line with the center of the lens, and take a few more feet. Do this for four or five different positions of the mask. Do the same with the other masks, making a careful notation in a notebook each time the mask is moved, and the scene number corresponding to its position, so that they can be identified when the film is projected. When your film is developed and you project it, it will show you how the different masks mask the image on the film.

The box can be simply constructed out of black cardboard or thin tin painted a dead, matte black. This last point is important. A shiny black is likely to reflect the rays of light entering the lens through the box.

The length of the box has been determined by the position of the masks as ascertained by the previous tests. The box is simply a cone, the narrow end made to fit snugly over the lens barrel and pushed flush up against the diaphragm ring so that it will always be in the same position when placed over the lens. Narrow slits into which the masks may be slid are cut on both sides of the box at the points marked by the mask test that has just been made.

The masks are inserted, a white line on either side of the mask frame indicating the points to which they must be inserted so that they will be in the exact position they occupied when the test shots were made. Be sure to cut the slits in the box so the borders of the masks when inserted will be parallel to the film in the camera. This does not make so much difference when a circular opening is used in a mask, but when a rectangular, oval or other shape is used the effect on the film will be destroyed unless the mask is inserted accurately.

For further accurate mounting of the mask box, a white line should be marked on the top center of the lens barrel and another on the exact top center of the box. These should be made to coincide with the box slipped over the lens barrel. Be sure that the mask box flares out at a wide enough angle from the narrow to the large end so that the box itself will not cut off any of the picture. Between three and five inches should be enough for the diameter of the cone for 16 mm. cameras.

USE REFLECTORS TO CONTROL LIGHTING

EVERY amateur should take a tip from the professional cameraman and use reflectors when he shoots his pictures. There are any number of objects about the home that will serve splendidly as reflectors. The aluminum or beaded surface projection screen is an excellent "diffusing reflector." A small hand mirror, used in conjunction with the diffusing reflector, serves as a "spotting" reflector for accents of light. A large white sheet thrown on the ground in front of the subject will serve to soften the light and throw it into the subject. This type of reflector is particularly helpful when the face is shaded by large hats casting heavy shadows.

The above picture illustrates the correct use of reflectors. Note the circular overhead reflector used to break up the direct rays of sunlight that would result in harsh lighting.

These New "Trucking Shots" Give Effective Results in Amateur Films

Here is **Lon Chaney being photographed in a "trucking shot."** The amateur can adapt this method of photography to his own uses.

THE above photograph shows how the professional achieves a camera effect known as a "trucking" shot. As the character walks along the road the truck is pulled on ahead of him as he is photographed. Amateurs can get similar effects in their own films by using a small express wagon or a simple home-made truck with rubber-tired wheels for carrying the camera. The camera should be placed on a tripod in the wagon and all vibration reduced to a minimum by choosing a smooth, level path for the truck. Try this stunt in your next amateur production.

WHEN IN DOUBT, UNDER-EXPOSE

AMATEUR cameramen using Cine-Kodak reversible film have probably noticed that some films returned to them by the processing station are so light that when they are projected a washed-out, weak picture, lacking in detail, appears on the screen. This is a sure indication of over-exposure of the film. In other cases, the washed-out appearance is not so pronounced, but the picture is still too light and not satisfactory. Conversely, when the film is so dark that hardly any detail is visible on the screen, it is a sure sign of gross under-exposure. A slight under-exposure will yield a picture that is definitely more pleasing than a corresponding degree of over-exposure. The peculiarities of the reversible process exaggerate the effects of over-exposure, and hence, when in doubt as to the proper stop to use, always err on the under side.

When using the positive-negative, however, the opposite of the foregoing is true. An under-exposed negative film will be so thin that no detail is visible and the positive print made from it will be very poor in quality. On the other hand when a negative is over-exposed it means that the excess light acting on it has merely made the negative image denser, thereby insuring sufficient deposit of silver to the negative image so that a satisfactory print is sure to be obtained from it.

New Color Movies Projected Through Tinted Gelatine Shutters

Frederick T. O'Grady of Newark, N. J., is shown above holding the gelatin disc which is the secret of his new color movie invention.

A NEW natural color process, the O'Grady natural color film process, is soon to be available for 16 mm. films and cameras. This system is based on the Kinemacolor process invented many years ago. Ordinary panchromatic film is used and is exposed through a color wheel having two semi-circular segments, one of red and orange, the other of blue and green. The film is developed the same as any black and white panchromatic film and a print made in black and white from it. The projector is equipped with a different shutter blade than ordinarily. It consists of alternate transparent and semi-opaque segments of the seven colors of the spectrum. When the black and white print is projected through this all the colors of the original subject are produced with great fidelity. Flicker and fringing, the bane of color experimenters in the past, are practically eliminated. Frederick T. O'Grady, the inventor, has been perfecting his process for the past fifteen years and is at present engaged on the production of a 16 mm. color camera and projector.

IDEAL PROJECTION

WHEN showing films to a gathering of friends, place your projector, if possible, in one room and your screen and audience in another. If there are folding doors or portieres between the rooms, bring these together until they just allow the beam of light from the projector to get through to the screen. Setting up for a show in this way will eliminate the objectionable noise from the projector mechanism and add greatly to the enjoyment of the program. Turn on the radio or the phonograph and you will have a presentation that will compare favorably with that of your local movie theatre.

Veteran Boston Detective Has This Unique Clock

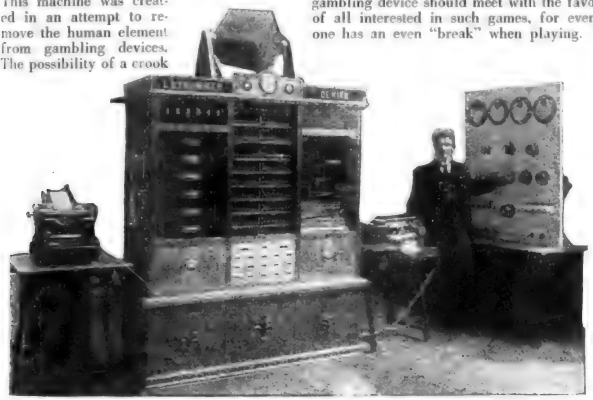
MORRIS WOLF, a veteran detective of the Boston, Mass., police force, received a very strange time-keeper on his 68th birthday. Detective Wolf was presented with a clock of many faces by his children. This clock contains, in place of figures, the photo likenesses of his twelve grandchildren. This gift is a very fitting reminder by which the head of this large family can always receive the message of love that it conveys. The leather case in which it is bound is hand embossed and makes the face stand out very clearly. The faces are raised and each one stands out from the surface in a very life-like manner.

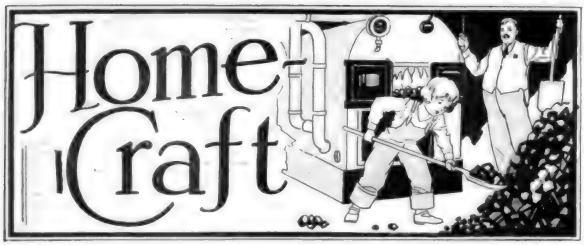
Mr. Wolf's unique clock adorns the desk that has been his place for over 30 years and there it pays him honor every minute.

This clock not only tells the time of day but also carries a message of love.

LOTTERY-MACHINE RENDERS DECEIT IMPOSSIBLE

WHEN the exhibition-halls in the Kaiserdam, Berlin, opened for the 6th International Bureau Exhibition, the first electric-automatic lottery machine in the world was among the many new inventions. This machine was created in an attempt to remove the human element from gambling devices. The possibility of a crook "throwing" the lottery to friends has been the chief fault of such games. This machine, by operating automatically from the drawing of lots to the posting of result lists, removes the human hand and thus makes deceit utterly impossible. Such a gambling device should meet with the favor of all interested in such games, for every one has an even "break" when playing.





Conducted by MRS. C. M. SULLIVAN

Years of experience as Household Service director of a large New York department store have qualified Mrs. Sullivan to be expert in charge of this department. She is a nationally known expert in her field and is constantly on the alert for new ideas and new inventions which will lighten the labor of the ordinary household tasks.

Resin Holds Loose Knife Handles Firmly in Place

WHEN the handle of a kitchen knife is not riveted to the shank of the blade itself, it sometimes works loose. Temporary repairs don't last long and finally the knife is thrown away, even though it was a good one.

One of the best ways to fasten such a handle firmly again is to pour powdered resin or sealing wax into the opening. Heat the shank in a clean flame (so it won't cause soot on the metal) and when quite hot plunge into the handle opening. The resin will melt and when hardened again will hold the blade firmly in place. Be sure to keep the blade in place until the resin has "set."

NEW DEVICE FRIES PERFECT DOUGHNUTS

A GREASELESS doughnut cooker for use on electric, oil or gas ranges is shown in the photograph at the left. It is claimed to be absolutely odorless in operation, and bakes a dozen doughnuts in a short time.

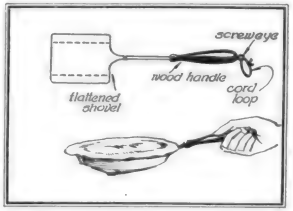
The device accommodates three doughnuts at a time and they are all perfectly shaped within the mold. The dough is deposited in the frier, which clamps shut something after the fashion of a waffle iron. The iron, of course, is well greased. The new system is claimed to be not only simple but economical as well.

Flattened Shovel Makes a Convenient Tool for Handling Hot Dishes

TO make a good hot dish remover for oven use, get a cheap shovel at the tenent store and carefully flatten out the sides with a hammer and anvil. The handle should be about 12 inches long, with a wooden piece at the end. This protects the hand even though the metal shaft does get uncomfortably warm.

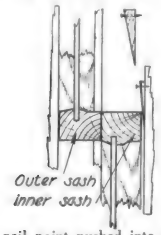
Over all, the paddle measures about 5 inches square, which is amply large for pie plates and medium-sized dishes.

Put a small screw-eye in the end and in this tie a 2-inch ring of heavy cord so the paddle can be hung up when not in use.



QUICK WINDOW LOCK

THE speed, neatness and effectiveness of this window lock is not affected by the fact that it is simple, cheap, easily made by anyone, and out of the very commonest materials. A wedge of hardwood, two inches long, with a small, sharp-pointed nail positioned in it as shown, and the lock is complete. Use judgment in the smaller dimensions, and you have a device that, once it is wedged between the inner sash rail and its inner engaging stop face and the point forced down and the nail point pushed into the wood, not only locks the window against possible intruders, but closes the space between the sashes, so excluding air. It is also a rattle preventive. The head of the nail should be allowed to project far enough from the wedge to provide a good finger grip.



BOILING WATER HEATS IRON

AN iron heated by pouring boiling water inside it was one of the novel exhibits at a recent display of new inventions in New York. The device was designed especially for the convenience of women travelers when a gas stove or other heating device is not handy. The iron retains its heat for a considerable length of time.

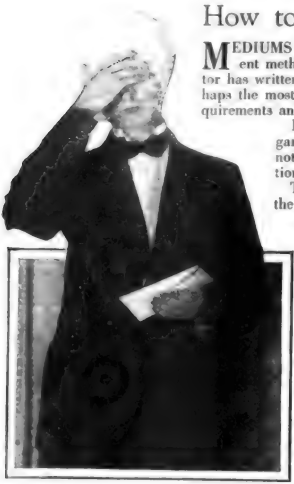
Puttying Storm Windows

WHEN washing storm windows preparatory to putting them on for the winter it is a good plan to examine the glass panes to make sure that they are securely mounted. If they are loose the winter winds are very likely to shatter them. Usually a bit of putty will be all that is needed to effect the necessary repairs.

A good putty can be made with whiting, a little white lead and enough linseed oil to render the compound elastic. Dipping the putty knife in water occasionally will make it slip smoothly over the putty so that a professional bevel can be given the seam.

Conducted by **MAHMUD SINGH**

THE dark secrets of Oriental magic are an open book to Mahmud Singh, conductor of this department of Modern Mechanics magazine. His early education in the ways of Indian magicians took place in Delhi, India, where he was born and where for several years he studied the secrets of the most famous conjurors of his country. Each month he creates new illusions for the readers of this department, or explains how old ones are performed by professionals.



How to Read Sealed Questions

MEDIUMS and crystal gazers employ hundreds of different methods of securing knowledge of what a spectator has written. The method about to be described is perhaps the most mysterious that is easily adapted to the requirements and restrictions of the amateur.

It is generally most effective to lecture regarding "second sight," explaining that it is nothing more than an advanced form of intuition or sixth sense.

Then pass out cards and envelopes. When the questions are written on the cards, instruct the spectators to seal them in the envelopes.

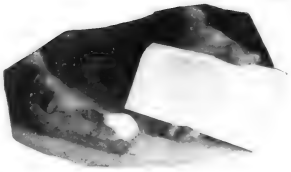
The envelopes are now collected in a pile, and held in the medium's left hand. By "concentrating," consisting of holding the right hand over the eyes, he answers the question more or less correctly, according to his mental abilities.

First, secure a small metal pill box, and in it place a sponge or cloth pad. The pad is moistened with odorless alcohol or spirits, obtainable of druggists.

With the envelopes in the left hand, and the pad gripped between the fingers on the inside of the right hand, you merely pass the pad quickly over the top envelope, which becomes transparent from the alcohol and allows you to read the question through the paper. The hand held over

the eyes assists in looking downward at the question without being detected. By the time you are ready to return the question, the alcohol will have evaporated, leaving no trace behind!

The photograph at the right shows the method of holding the moistening pad in the fingers so that the secret of the trick cannot be detected by the audience.



A CHAIR-RAISING FEAT!

A SIMPLE trick which will defeat even the strongest and which can be performed by the weakest member of any parlor gathering, is the following method of raising a chair.

Place an ordinary weight chair such as a kitchen chair flat on the floor with the two hind legs and the back resting flat. Invite the strongest man in the room to take hold of the end of one of the legs on the floor and raise the chair to a normal upright position with the one hand. He will fail.

The secret of performing the stunt lies in grasping the parlor chair at the extreme lower end of the leg. Most persons take hold a few inches up, and the result is that they do well enough in raising the chair until the protruding lower end of the chair leg touches the floor. Then it is the same story as that of a man trying to lift himself by his bootstraps. He cannot do it.

Take the chair at the extreme lower end of the leg, be sure that none of the leg extends beyond the grasp of your little finger, and using the finger as a fulcrum the average chair comes right up like a jack-in-the-box!

TELLING TIME WITHOUT READING THE CLOCK!

FOR this trick, you need only an ordinary clock and plenty of nerve. A spectator sets the clock at any hour and covers the face.

Before the experiment, set the clock at twelve o'clock and with a sharp knife or file make a tiny nick on the setting button in the back as shown above. The nick is made at the very top.

When you are blindfolded, touch the setting button with your finger, and by the position of the nick you can tell exactly the hour at which the clock is set.

Statues from Snapshots

By WALTER E. BURTON

YOUR favorite snapshots can be made into attractive statuettes for your desk or piano top by following the methods outlined in this article. All that is needed is a piece of cardboard, a saw, and glue.

SOMETHING different in photographic decorations can be easily produced by converting pictures of friends, buildings, animals or other objects into attractive "photo-figures." These consist essentially of photographic figures mounted on stiff supports, with all surrounding detail cut away, and arranged so that they will remain upright, much like little statues.

First you will need a suitable picture. That of some prominent object, such as one or, at most, two individuals, is best. If you take the picture yourself, you will be repaid for spending a little extra time in posing the figure. If you are photographing, say, a lady friend, make it a full-length view. The pose should be one that is not too formal, but should be as natural as possible. The lady may be sitting or standing, as you prefer.

Next an enlargement is made on smooth-surface paper, so that the figure is of a suitable height. Usually about six or eight inches is satisfactory. Of course, a contact print, if the figure is large enough, can be used. After excess parts of the print are trimmed away, the remaining picture is mounted on a piece of stiff cardboard, a good-quality glue being used. When thoroughly dry, the figure is carefully cut out with the aid of a safety razor blade or other sharp instrument. At the base of the figure, a little of the surrounding detail is included so that a top-heavy statue will not result, and also that the fastening of the base will be easier. This portion may be formed in a pleasing shape with the aid of a compass or draughtsman's curve.

Unless very heavy cardboard is used, the figure will warp. Besides, thick edges are

These Photographs Show Several Progressive Steps in the Making

At the left the snapshots are shown mounted on cardboard, with the bottom-lugs outlined for cutting. In the center is shown the method of cutting out the cardboard-backed figure. A scroll saw is used when the figure is mounted on wood.

not desirable because they are too prominent. Therefore a re-enforcing back is cut from wood to conform roughly with the outline, but a little smaller than the figure. The thickness of this wooden back should be about one-eighth inch. The re-enforcing piece is rounded on one surface so that the edges are thin, and the other or flat side is glued to the back of the cardboard cut-out.

There are a variety of ways of making the base. One is to cut a block from a piece of hard wood, such as maple; carefully plane and sandpaper the surfaces, and paint with black drawing ink. When the ink is dry, a coat of floor wax is applied. In cutting out the figure, a small lug is left projecting below the base line, if this type of base is to be used. The lug fits into a hole cut into the base. Another method of forming a support is to form a circular disc of wood, preferably on a lathe, and then saw it into two semi-circular pieces. One of these is glued to the back of the cut-out, so that the figure seems to stand on the surface of the table or other support. If you desire to make a very elaborate job of it, you can cut and polish a base from a piece of marble. This, however, is somewhat beyond the abilities of the average amateur.

Finishing touches are given by painting the back and edges of the figure and, if desired, the base, with a quick-drying lacquer of suitable color. Care should be taken not to smear the surface of the picture. The photographic surface can be left as it is, or can be protected by a coating of photographic varnish or ordinary floor wax rubbed to a gloss.

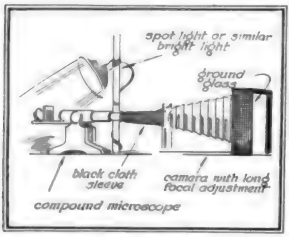
A more simple but not quite so attractive method of making photo-figures is to paste the picture on a thin piece of plywood or cigar box wood, cut out the figure with a scroll saw, smooth the edges, mount upright on one of the bases described, and then apply lacquer or paint. Care should be taken that the surface of the wood is absolutely smooth and that the grain is not too prominent, else surface irregularities in the picture will be noticeable. The main disadvantage of this method is the relatively thick edges which result and the danger of ruining the figure by splitting, especially near the edges.

Cut-outs made according to either of the methods described are considerably more attractive than the more conventional photograph. They make ideal gifts. The appearance can be improved by coloring the picture with water or oil paints, such as those made especially for coloring photographs.

of Interesting Statues from Snapshots, Using Cardboard for Mounting

The photo at the left shows how the wooden support for the cardboard mounting is applied, its edges slightly narrower than the outline of the figure. The other two pictures show the appearance of the finished statuettes.

Microscope and a Camera Easily Combined for Microphotography



IF YOU have a camera and a microscope—even a simple glass—you can combine them to take microphotographs.

The exact type of apparatus to use will depend almost entirely upon your own equipment, but the arrangement is in most cases similar to that shown in the diagram. The microscope is tilted over on its side and the lens of the camera brought a certain distance from, and in line with, the microscope eye piece. To exclude light—and a powerful light will be required for making photo-enlargements of the scenes on the slides—a sleeve of black oil cloth or other black, opaque material is used to connect them.

Considerable skill will be required to adjust the arrangement to bring the image in clear focus on the ground glass. The best way to do this is to use a low-power lens in the microscope first, and with a bright light thrown on the slide, adjust the camera to bring out the detail clearly.

PITH BEST LENS CLEANER

One of the most effective agents for cleaning camera lenses is the pithy center from a sapling of box elder or other wood. After the lens is cleaned the pith can easily be blown off.

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Turn to page 18 of this magazine and read the complete rules of the contest which you will find printed there. Pictures of the six movie stars to be identified also appear on that page. Here is a chance for every movie fan to test his wits and win one of the cash prizes. Simply supply the missing names and write 50 to 100 words telling which one of these stars is your favorite, and why.

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CONQUEST of

(*Continued from Page 135*)

"One is either a friend or an enemy," replied Ko-tah.

"I am not sufficiently well acquainted to be accounted either," I told him; "nor shall I choose my friends in Laythe until I am better acquainted, nor shall another choose them for me."

"You are a stranger here," said Ko-tah. "I speak in your best interests, only. If you would succeed here; aye, if you would live, even, you must choose quickly and you must choose correctly. I, Ko-tah the Javadar, have spoken."

"I choose my own friends," I replied, "according to the dictates of my honor and my heart. I, Ju-lan the Javadar, have spoken."

He bowed low in acquiescence, and when he again raised his eyes to mine I was almost positive from the expression in them that his consideration of me was marked more by respect than resentment.

"We shall see," was all that he said, and withdrew, leaving me to the kindly attention of some of the gentlemen of Sagroth's court who had been standing at a respectful distance out of earshot of Ko-tah and myself. These men chatted pleasantly with me for some time until I was bidden to join Sagroth in another part of the palace.

Sagroth the Jemadar

I FOUND myself now with a man who had evidently thrown off the restraint of a formal audience, though without in the slightest degree relinquishing either his dignity or his majesty. He spoke more freely and his manner was more democratic. He asked me to be seated, nor would he himself sit until I had, a point of Laythean court etiquette which made a vast impression on me, since it indicated that the first gentleman of the city must also be the first in courtesy. He put question after question to me concerning my own world and the means by which I had been transported to Va-nah.

"There are fragmentary, extremely fragmentary, legends handed down from extreme antiquity which suggest that our re-

the MOON

mote ancestors had some knowledge concerning the other worlds of which you speak," he said, "but these have been considered always the veriest of myths. Can it be possible that, after all, they are based upon truth?"

"The remarkable part of them," I suggested, "is that they exist at all, since it is difficult to understand how any knowledge of the outer Universe could ever reach to the buried depths of Va-nah."

"No, not by any means," he said, "if what you tell me is the truth, for our legends bear out the theory that Va-nah is located in the center of an enormous globe and that our earliest progenitors lived upon the outer surface of this globe, being forced at last by some condition which the legends do not even suggest, to find their way into this inner world."

I shook my head. It did not seem possible.

"And, yet," he said, noting the doubt that my expression evidently betrayed, "you yourself claim to have reached Va-nah from a great world far removed from our globe which you call the Moon. If you reached us from another world, is it then so difficult to believe that those who preceded us reached Va-nah from the outer crust of this Moon? It is almost an historic certainty," he continued, "that our ancestors possessed great ships which navigated the air. As you entered Va-nah by means of a similar conveyance, may not they have done likewise?"

I had to admit that it was within the range of possibilities, and in so doing, to avow that the Moon Men of antiquity had been millions of years in advance of their brethren of the Earth.

But, after all, was it such a difficult conclusion to reach when one considers the fact that the Moon being smaller, must have cooled more rapidly than Earth, and therefore, provided that it had an atmosphere, have been habitable to man ages before man could have lived upon our own planet?

The Princess Snubs Me

HE TALKED pleasantly upon many subjects for some time, and then, at last, Sagroth arose.

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Conquest of the MOON

"We will join the others at the tables now," he said, and as he led the way from the apartment in which we had been conversing alone, stone doors opened before us as by magic, indicating that the Jemadar of Laythe was not only well served, but well protected, or possibly well spied upon.

After we emerged from the private audience, guards accompanied us, some preceding the Jemadar and some following, and thus we moved in semi-state through several corridors and apartments until we came out upon a balcony upon the second floor of the palace overlooking the terraces and the crater.

Here, along the rail of the balcony, were numerous small tables, each seating two, all but two of the tables being occupied by royal and noble retainers and their women. As the Jemadar entered, these all arose, facing him respectfully, and simultaneously through another entrance, came the Jemadar and Nah-ee-lah.

They stood just within the room, waiting until Sagroth and I crossed to them. While we were doing so, Sagroth very courteously explained the procedure I was to follow.

"You will place yourself upon the Nonovar's left," he concluded, "and conduct her to her table precisely as I conduct the Jemadav."

Nah-ee-lah's head was high as I approached her and she vouchsafed me only the merest inclination of it in response to my respectful salutation. In silence we followed Sagroth and his Empress to the tables reserved for us. The balance of the company remained standing until, at a signal from Sagroth, we all took our seats. It was necessary for me to watch the others closely, as I knew nothing concerning the social customs of Laythe, but when I saw that conversation had become general I glanced at Nah-ee-lah.

"The Princess of Laythe so soon forgets her friends?" I asked.

"The Princess of Laythe never forgets her friends," she replied.

"I know nothing of your customs here," I said, "but in my world even royalty may greet their friends with cordiality and seeming pleasure."

"And here, too," she retorted.

by Edgar Rice Burroughs

I saw that something was amiss, that she seemed to be angry with me, but the cause I could not imagine. Perhaps she thought I had deserted her at the entrance to the tunnel leading to the Kalkar city. But no, she must have guessed the truth. What then, could be the cause of her cold aloofness, who, the last that I had seen of her, had been warm with friendship?

"I wonder," I said, trying a new trick, "if you were as surprised to see me alive as I you. I had given you up for lost, Nah-ee-lah, and I had grieved more than I can tell you. When I saw you in the audience chamber I could scarce repress myself, but when I saw you did not wish to recognize me, I could only respect your desire."

Conspirators of Ko-tah

SHE MADE no reply, but turned and looked out the window across the terraces and the crater to the opposite side of Laythe. She was ice, who had been almost fire. No longer was she little Nah-ee-lah, the companion of my hardships and dangers. No longer was she friend and confidante, but a cold and haughty Princess, who evidently looked upon me with disfavor. Her attitude outraged all the sacred tenets of friendship, and I was angered.

"Princess," I said, "if it is customary for Laytheans thus to cast aside the sacred bonds of friendship, I should do as well to be among the Va-gas or the Kalkars."

"The way to either is open," she replied haughtily. "You are not a prisoner in Laythe."

Thereafter conversation languished and expired, as far at least, as Nah-ee-lah and I were concerned, and I was more than relieved when the unpleasant function was concluded.

Two young nobles took me in charge, following the meal; as it seemed that I was to remain as a guest in the palace for awhile, and as I expressed a desire to see as much of the imperial residence as I might be permitted to, they graciously conducted me upon a tour of inspection. We went out upon the outer terraces which overlooked the valleys and the mountains, and never in my life have I looked upon a landscape more majestic or inspiring. The crater of Laythe, situated upon a broad plateau en-

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Conquest of the MOON

tirely surrounded by lofty mountains, titanic peaks that would dwarf our Alps into insignificance and reduce the Himalayas to foothills, lowered far into the distance upon the upper side, the ice-clad summits of those more distant seemed to veritably topple above us, while a thousand feet below us the pinks and lavenders of the weird lunar vegetation lay like a soft carpet upon the gently undulating surface of the plateau.

But my guides seemed less interested in the scenery than in me. They plied me with questions continually, until I was more anxious to be rid of them than aught else that I could think of. They asked me a little concerning my own world and what I thought of Laythe, and if I found the Princess Nah-ee-lah charming, and my opinion of the Emperor Sagroth. My answers must have been satisfactory, for presently they came very close to me and one of them whispered:

"You need not fear to speak in our presence. We, too, are friends and followers of Ko-tah."

I Join the Plotters

"THE DEVIL!" I thought. "They are bound to embroil me in their petty intrigues. What do I care for Sagroth or Ko-tah or"—and then my thoughts reverted to Nah-ee-lah. She had treated me cruelly. Her cold aloofness and her almost studied contempt had wounded me, yet I could not say to myself that Nah-ee-lah was nothing to me. She had been my friend and I had been hers, and I should remain her friend to my dying day. Perhaps, then, if these people were bound to draw me into their political disputes, I might turn their confidences into profit for Nah-ee-lah. I had never told them that I was a creature of Ko-tah's for I was not, nor had I ever told Ko-tah that I was an enemy to Sagroth; in fact, I had led him to believe the very opposite. And so I gave these two an evasive answer which might have meant anything, and they chose to interpret it as meaning that I was one of them. Well, what could I do? It was not my fault if they insisted upon deceiving themselves, and Nah-ee-lah might yet need the friendship that she had scorned.

"Has Sagroth no loyal followers, then,"

by Edgar Rice Burroughs

I asked, "that you are all so sure of the success of the *coup d'etat* that Ko-tah plans?"

"Ah, you know about it then!" cried one of them. "You are in the confidence of the Javadar."

I let them think that I was. It could do no harm, at least.

"Did he tell you when it was to happen?" asked the other.

"Perhaps, already I have said too much," I replied. "The confidences of Ko-tah are not to be lightly spread about."

"You are right," said the last speaker. "It is well to be discreet, but let us assure you, Ju-lan the Javadar, that we are equally in the confidence and favor of Ko-tah with any of those who serve him; otherwise, he would not have entrusted us with a portion of the work which must be done within the very palace of the Javadar."

"Have you many accomplices here?" I asked.

"Many," he replied, "outside of the Jemadar's guards. They remain loyal to Sagroth. It is one of the traditions of the organization, and they will die for him, to a man, and," he added with a shrug, "they shall die, never fear. When the time arrives and the signal is given, each member of the guard will be set upon by two of Ko-tah's faithful followers."

The Mysterious Kalkar

I do not know how long I remained in the City of Laythe. Time passed rapidly, and I was very happy after I returned to the dwelling of Moh-goh. I swam and dived with them and their friends in the baths upon our terrace, and also in those of Ko-tah. I learned to use the flying wings that I had first seen upon Nah-ee-lah the day that she fell exhausted into the clutches of the Va-gas, and many were the lofty and delightful excursions we took into the higher mountains of the Moon, when Moh-goh or his friends organized pleasure parties for the purpose. Constantly surrounded by people of culture and refinement, by brave men and beautiful women, my time was so filled with pleasurable activities that I made no effort to gauge it. I felt that I was to spend the balance of my life here, and I might as well get from it all the pleasure that Laythe could afford.

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Conquest of the MOON

I did not see Nah-ee-lah during all this time, and though I still heard a great deal concerning the conspiracy against Sagroth, I presently came to attach but little importance to what I did hear, after I learned that the conspiracy had been on foot for over thirteen kelds, or approximately about ten earthly years, and seemed, according to my informers, no nearer consummation than it ever had been in the past.

Time does not trouble these people much, and I was told that it might be twenty kelds before Ko-tah took action, though on the other hand, he might strike within the next ola.

There was an occurrence during this period which aroused my curiosity, but concerning which Moh-goh was extremely reticent. Upon one of the occasions that I was a visitor in Ko-tah's palace, I was passing through a little used corridor in going from one chamber to another, when just ahead of me a door opened and a man stepped out in front of me. When he heard my footsteps behind him he turned and looked at me, and then stepped quickly back into the apartment he had just left and closed the door hurriedly behind him. There would have been nothing particularly remarkable in that, had it not been for the fact that the man was not a Laythean, but unquestionably a Kalkar.

Believing that I had discovered an enemy in the very heart of Laythe, I leaped forward, and throwing open the door, followed into the apartment into which the man had disappeared. To my astonishment, I found myself confronted by six men, three of whom were Kalkars, while the other three were Laytheans, and among the latter I instantly recognized Ko-tah, himself. He flushed angrily as he saw me, but before he could speak I bowed and explained my action.

I Spy on the Conspirators

"I crave your pardon, Javadar," I said. "I thought that I saw an enemy of Laythe in the heart of your palace, and that by apprehending him I should serve you best"; and I started to withdraw from the chamber.

"Wait," he said. "You did right, but lest you misunderstand their presence here, I

by Edgar Rice Burroughs

may tell you that these three are prisoners."

"I realized that at once when I saw you, Javadar," I replied, though I knew perfectly that he had lied to me; and then I backed from the room, closing the door after me.

I spoke to Moh-goh about it the next time that I saw him.

"You saw nothing, my friend," he said. "Remember that—you saw nothing."

"If you mean that it is none of my business, Moh-goh," I replied, "I perfectly agree with you, and you may rest assured that I shall not meddle in affairs that do not concern me."

However, I did considerable thinking upon the matter, and possibly I went out of my way a little more than one should who is attending strictly to his own business, that I might keep a little in touch with the course of the conspiracy, for no matter what I had said to Moh-goh, no matter how I attempted to convince myself that it did not interest me, the truth remained that anything that affected in any way the fate of Nah-ee-lah transcended in interest any event which might transpire within Va-nah, in so far as I was concerned.

The unobtrusive espionage which I practiced bore fruit, to the extent that it permitted me to know that on at least three other occasions delegations of Kalkars visited Ko-tah.

The fact that this ancient palace of the Prince of Laythe was a never-ending source of interest to me aided me in my self-imposed task of spying upon the conspirators, for the retainers of Ko-tah were quite accustomed to see me in out-of-the way corridors and passages, oftentimes far from the inhabited portions of the building.

Upon the occasion of one of these tours I had descended to a lower terrace, along an ancient stone stairway which wound spirally downward and had discovered a dimly lighted room in which were stored a number of ancient works of art. I was quietly examining these, when I heard voices in an adjoining chamber.

Ko-tah Prepares to Strike

"Upon no other conditions will he assist you, Javadar," said the speaker, whose voice I first heard.

"His demands are outrageous," replied

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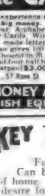

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Conquest of the MOON

a second speaker. "I refuse to consider them. Laythe is impregnable. He can never take it." The voice was that of Ko-tah.

"You do not know him, Laythean," replied the other. "He has given us engines of destruction with which we can destroy any city in Va-nah. He will give you Laythe. Is that not enough?"

"But he will be Jemadar of Jemadars and rule us all!" exclaimed Ko-tah. "The Jemadar of Laythe can be subservient to none."

"If you do not accede he will take Laythe in spite of you and reduce you to the status of a slave."

"Enough, Kalkar!" cried Ko-tah, his voice trembling with rage. "Be gone! Tell your master that Ko-tah refuses his base demands."

"You will regret it, Laythean," replied the Kalkar, "for you do not know what this creature has brought from another world in knowledge of war and the science of destruction of human life."

"I do not fear him," snapped Ko-tah.

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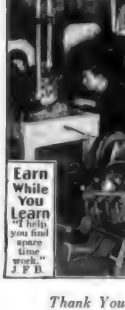

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by Edgar Rice Burroughs

"my swords are many, my spearmen are well trained. Be gone, and do not return until your master is ready to sue with Ko-tah for an alliance."

I heard receding footsteps then, and following that, a silence which I thought indicated that all had left the chamber, but presently I heard Ko-tah's voice again.

"What think you of it?" he asked. And then I heard the voice of a third man, evidently a Lay:hean, replying:

"I think that if there is any truth in the fellow's assertions, we may not too quickly bring about the fall of Sagroth and place you upon the throne of Laythe, for only thus may we stand united against a common outside enemy."

"You are right," replied the Javadar. "Gather our forces. We shall strike within the ola."

I wanted to hear more, but they passed out of the chamber then, and their voices became only a subdued murmur which quickly trailed off into silence. What should I do? Within six hours Ko-tah would strike at the power of Sagroth, and I well knew what that would mean to Nah-ee-lah; either marriage with the new Jemadar, or death, and I guessed that the proud Princess would choose the latter in preference to Ko-tah.

Return of the Barsoom

I ASCENDED the terrace toward the Palace of the Jemadar, intending to report my discovery of Ko-tah's treachery, but I had scarcely stepped into the open air than I became aware that something had aroused the excitement of the citizens of Laythe. Following their excited glances, I observed a tiny elongated speck taking shape in the distant sky. At first I thought it was a bird of some huge species which I had never seen, but I gathered from the conversation of those about me that the object was not a bird, but something strange and fearsome which terrified and yet fascinated them.

A sudden shaft of light glinted from the sides of the distant object, and for a moment my heart stood still with a hope which I dared not express even to myself. That gleam of light had been reflected from something metallic—and I knew of only one metal monster capable of flying on the Moon. That was the *Barsoom*!

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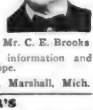

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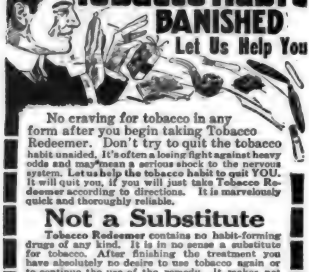

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Conquest of the MOON

I must confess that I was torn between joy and despair as I watched the object gradually take form. If my comrades *were* aboard the ship—if it actually was the *Barsoom*—how could I let them know that I was in the city ready to greet them? Possibly they would pass the city by, not knowing what sort of reception the unknown citizens of Laythe might accord them.

Expressions of wonder rose from the lips of the staring Laytheans as the ship came above the city. It was the *Barsoom*—there could be no doubt about it. It sailed above us as proudly as on that distant day when we set forth from the earth. I could even see the head and shoulders of a man projecting above the cockpit door, and I fancied that I recognized Ensign Norton, though in this I might have been mistaken.

Observing that the *Barsoom* would pass close by the topmost terrace of the city, I made my way up the terrace as fast as I could run. And as I ran I permitted myself to wonder how the *Barsoom* had been made to fly again. The ship had been hopelessly disabled. Had Orthis found the ship and taken charge once more, applying his profound knowledge of the mysteries of the Eighth Ray to repair the shattered tanks? Was he, perhaps, in control of the ship now, having subdued or won over my three lost comrades?

But when I reached the pinnacle of the city all my doubts vanished. The *Barsoom* was so close now that I could almost reach out and touch her gleaming sides. She hung motionless alongside the topmost terrace.

The cockpit was empty when I first saw it, but in a moment a head appeared. Beneath the jaunty officer's cap I recognized the smiling face of Ensign Norton.

His expression of surprise was ludicrous when he recognized me. For a moment he was utterly beyond speech; then he shouted something at me which I could not understand and disappeared. But he was back again almost at once, and at his side were Lieutenants West and Jay. Their surprise and joy in seeing me was no less than my own in finding them again. They finally navigated the ship so close to where I stood that I could converse with them comfortably.

by Edgar Rice Burroughs

"We had given you up for lost, sir," said Ensign Norton. "I can't tell you how glad we all are to see you once more. Is Commander Orthis with you?"

"No," I said, and with some bitterness I told them of Orthis' reprehensible conduct since we had left them. As I talked I saw Norton and the others exchange glances.

A Warship of the Sky

I THINK we can tell you what has become of Orthis," said Lieutenant West. "When we started on our flight a few hours ago, we came up alongside the mouth of a huge crater extending up from the floor of the Moon. We were just topping the summit when Norton, who was handling the controls, suddenly stopped the ship

"'Look up there—across the crater!' he shouted. Following his pointing finger, we saw an astonishing sight. Perhaps half a mile ahead of us floated a strange craft twice as large as the *Barsoom*. In general shape it was very similar to our own ship, but it was fitted with several conical projections extending from its sides which emitted steady flashes of lightning—at least, that is what it seemed like to us. The whole was connected up with a maze of metal tubing, and on the upper deck was a queer device something like the guns they used to use on earth before war was abolished.

"While we watched a tremendous burst of red light flared out from the end of the gun. It was pointing towards a small crater a quarter of a mile away.

"One minute the crater was there—the next it had disappeared; nothing remained but a cloud of dust slowly rising from the spot where the crater had been.

"I tell you, sir, it was an amazing exhibition, and it left us speechless and just a little frightened. We could not help wondering what would have become of us if *we* had been in the path of those destructive rays, whatever they were. You can believe that we kept well under cover of the crater until the queer craft had moved out of sight. Two other ships exactly like it trailed it at a short distance.

"At the time we thought we had encountered a warship of the air built by some nation of the Moon. But now that you have told us of the disappearance of Commander

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Conquest of the MOON

Orthis, I am inclined to believe, sir, that he was the builder and inventor of the machine!"

"I believe Lieutenant West is right," broke in Norton. "It was I who repaired the broken Eighth Ray tanks so that the *Barsoom* could fly again. You will remember that I asked permission to bunk with Orthis aboard the ship, and I took advantage of the opportunity to gain as much information as I could concerning the operation of the Eighth Ray tanks. We frequently had long conversations together, and he told me once about a terrible new weapon of destruction he had devised—a weapon that would turn matter into dust. I am convinced, sir, that the ship we saw was built by Orthis!"

I nodded. In truth, I had little doubt but that Norton and West were right. If any man possessed a mind brilliant enough to produce such a machine as they described to me, that man was Orthis.

by Edgar Rice Burroughs

"You had best land the *Barsoom* on this upper terrace," I said, suddenly remembering that I had been on my way to report Kotah's treachery to the Jemadar. I suddenly recognized that the *Barsoom* offered a means of escape for Sagroth and the Princess—and myself as well. Leaving a few of the loyal palace guards to stand watch over the *Barsoom*, I explained matters briefly to my three comrades and took my leave.

Swordplay

AS RAPIDLY as I could I made my way toward the palace of the Jemadar. I had never presented myself at Sagroth's palace since Nah-ee-lah had so grievously offended me. I did not even know the customary procedure to follow to gain an audience with the Emperor, but nevertheless, I came boldly to the carven gates and demanded to speak with the officer in command of the guards. When he came I told him that I desired to speak either with Sagroth or the Princess Nah-ee-lah at once, upon a matter of the most urgent importance.

"Wait," he said, "and I will take your message to the Jemadar."

He was gone for what seemed to me a very long time, but at last he returned, saying that Sagroth would see me at once, and I was conducted through the gates and into the palace toward the small audience chamber in which Sagroth had once received me so graciously. As I was ushered into the room I found myself facing both Sagroth and Nah-ee-lah. The attitude of the Jemadar seemed apparently judicial, but that of the Princess was openly hostile.

"What are you doing here, traitor?" she demanded, without waiting for Sagroth to speak, and at the same instant a door upon the opposite side of the room burst open and three warriors leaped into the apartment with bared swords.

"I have come to defend the life of the Jemadar and his Princess," I cried, as I sprang between them and the advancing three.

"What means this?" demanded Sagroth. "How dare you enter the presence of your Jemadar with drawn sword?"

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Conquest of the MOON

slay you!" I cried. "Defend yourself, Sagroth of Laythe!" And with that, I tried to engage the three until help arrived.

I Defend the Jemadar

ONE OF OUR antagonists merely tried to engage me while the other two assassinated the Jemadar. And so, seeing that he was playing me, and that I could do with him about as I pleased if I did not push him too hard, I drove him back a few steps until I was close at the side of one of those who engaged Sagroth. Then before any could know my intention, I wheeled and lunged my sword through the heart of one who opposed the father of Nah-ee-lah.

It was man against man, now, and the odds were even. I had no opportunity to watch Sagroth, but from the ring of steel on steel, I knew that the two were bitterly engaged. My own man kept me well occupied. He was a magnificent swordsman, but he was only fighting for his life; I was fighting for more—for my life and for my honor, too, since after the word "traitor" that Nah-ee-lah had hurled at me, I had felt that I must redeem myself in her eyes.

I could catch an occasional glimpse of her standing there behind the massive desk at which her father had sat upon the first occasion of my coming to this chamber. She stood there very tense, her wide eyes fixed upon me in evident incredulity.

I had almost worn my man down and we were fighting now so that I was facing Nah-ee-lah, with my back toward the doorway through which the three assassins had entered. Sagroth must have been more than holding his own, too, for I could see his opponent slowly falling back before the older man's assaults. And then there broke above the clang of steel a girl's voice—Nah-ee-lah's—raised in accents of fear.

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Make $12 a day and liberal bonus selling Pioneer $23.50 and $33.50 all-wool tailoring. Commissions paid daily. Identical large cloth samples furnished. We train the inexperienced. Write Pioneer Tailoring Co., Cincinnati Branch, Dept. A1272, O.

Don't Sell for Others. Employ Agents yourself. Make your own products. Toilet Goods, Soaps, Extracts, etc. 500% profit. Valuable book Free. National Scientific Labs., 1929 Broad, Richmond, Va.

Get Big Pay Auto Job! Learn in 8 weeks. Special tuition rates. R. R. Passes included. Free Book. Cleveland Auto School, Dept. E-26, Cleveland, Ohio.

BRAND NEW. $10 Hourly. Big Repeater. Backed by National Chain organization. Get free sample. McNUZit System, 152 E. Erie, Chicago.

Forest Rangers $125 a month. Home Furnished. Railway Mail. Post Office Clerks, Carriers, Rural Carriers. Free Details. Write Nicholson Institute, 733, Denver, Colo.

Men, get Forest Ranger job; $125-$200 month and home furnished; hunt, fish, trap. For details, write Norton Institute, 1523 Temple Court, Denver, Colo.

Amazing New Glass Cleaner offers you $15 a day sure! Cleans windows, windshields, show cases, etc., without water, soap or chamois. No muss. Easily demonstrated. Housewives, motorists, storekeepers, institutions buy on sight. Write for Special Introductory Offer. Glass Cleaner Co., 2539 Monmouth, Cincinnati, Ohio.

Something New! Latest Craze—Rubber Art Rugs in attractive patterns and colors. Practical, serviceable, economical. Soft, easy on feet. Most women buy 3. Agents cleaning up! Make $90 weekly. Also 67 other fast selling rubber specialties. Free outfit. Write today. Kristee Mfg. Co., 1501 Bar Street, Akron, Ohio.

Men who like to travel. Work romantic South America. American firms pay fare, expenses. Free list. South American Service Bureau, 14600 Alma, Detroit, Mich.

How do you SPELL YOUR NAME?

In the window, top, body, wheel, or under the fender of the Buick Sedan pictured here are certain lucky letters cleverly worked into the picture by the artist. Can you find even one of these letters which appears in your last name?

TELL ME the letter you have found in the car. Remember, this letter must appear somewhere in your last name. Send it to me with your name and address and I'll start you at once giving away four autos and many other prizes. You may be the one who will write me

AND WIN BUICK SEDAN or $1800 Cash

CERTIFICATE FOR $480.00 TO APPLY ON GRAND PRIZE SENT IMMEDIATELY AS BELOW IF YOU FIND A LETTER

Immediate quick action—so today—we send Certificate for $480.00 to add to the first prize, if you win, and directions for getting Buick Sedan. Prizes given to introduce our products locally. Big new FRIENDSHIP CAMPAIGN of this 80 year old concern. This offer is simple and straight. No more puzzles to solve. No lists of words to make or write or say other puzzles. This is all. First prize winner gets $480.00 just quickness to answer. Mrs. Ira Francis, Ky., writes: "I got $480.00." Mrs. Wandus, J. O. Long, Effie Swearingen won cars on our last ads. No cost or obligation now, later, or ever. Everyone rewarded if actively interested. If you can find one of the hidden letters in your name, send it right away by letter. That's all.

B. H. FRANCE, DEPT. 78, 500 N. DEARBORN ST., CHICAGO

$1500 CASH IN PRIZES !!!

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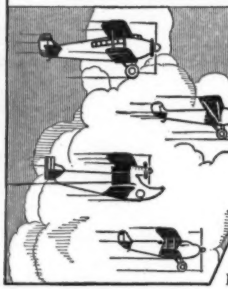
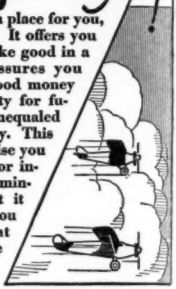
There's Golden Opportunity in the Air!



Aviation has a place for you, young fellow! It offers you a chance to make good in a big way! It assures you pleasant work, good money and an opportunity for future development unequaled in any industry today. This school does not promise you a stupendous salary nor insure you a big job the minute you've soloed. But it does guarantee to give you the thorough, intelligent training which opens the door of opportunity for you. It gives you



NEW, LICENSED PLANES, CAREFULLY MAINTAINED AND REGULARLY INSPECTED ▲▲ COMPLETE AND THOROUGHLY MODERN EQUIPMENT ▲▲ TRANSPORT PILOTS, LICENSED MECHANICS, LEADING ENGINEERS AND BUILDERS — ALL VETERANS IN THE INDUSTRY—AS YOUR INSTRUCTORS ▲▲ THE FINEST POSSIBLE GROUND TRAINING AT FACTORY AND FIELD OF ONE OF AMERICA'S FINEST AIRCRAFT COMPANIES

This school will give you the foundation upon which to build an assured future if you have the energy and foresight to qualify for the opportunities Aviation offers you. The finest flying weather of the year right now at our field. Start right now—be ready for 1929—Aviation's biggest year! Clip the coupon—and *use* it today!

THE PORTERFIELD FLYING SCHOOL, Inc.
Kansas City, Mo.

Porterfield Flying School, Inc.,
Room 102, Kirkwood Bldg.,
Kansas City, Mo.

Please send at once my copy of "A Flying Message," the 32-page booklet describing your school and my opportunity in Aviation.

Name .....
Address ..... Age .....
City ..... State .....

I'll Pay Your Bills

and give you a steady Income for the rest of your life—

if you will take care of my business in your locality. No experience needed. Pleasant, easy work, can be handled in spare or full time.

No Investment Needed

I furnish all capital—I set you up in business, advertise you, and do everything to make you my successful and respected partner in your locality. I will make you my partner in my fast growing, established business—but I don't ask you to invest a single penny. Everything is furnished to you FREE—just look after the established business in your locality and we will split the money 50-50! Partner may be either man or woman. All I ask is that you have ambition and can devote a few hours each day to distributing my famous products to friends and a list of established customers. High grade food products, teas, coffee, spices, extracts, things people must have to live.

Your Groceries at Wholesale

As my partner I furnish your groceries at wholesale — I do everything to see that my partners get all the advantages of Big Business. Big FREE supply contains over 32 full size packages of highest quality products. Choose all your groceries, at wholesale, from my big list of over 300 home necessities. Quality backed by $25,000.00 Bond.

Iron-Clad Guarantee to You of $15 a Day Steady Income

LOOK!

$117.50 First 5 Days
"Made $117.50 first 5 days. Your products are marvelous. Anyone can easily make money with Health-O." — A. Pelletier, Mass.

Always Sure of $10 a Day
Mrs. Bower, a W. Va., housewife writes: "I am always sure of $10 a day profit with Health-O Products."

$31.65 First Day
"Just received sample case. Started among acquaintances and first day made $31.65."—B. L. Simmons, So. Car.

$101.25 First Week
Ruth Hoffman never sold a thing before in her life. She proved that experience was not necessary—she writes: "Made $101.25 first week."

$21.85 in Two Evenings
"F. J. Osborne two days after receiving sample case enthusiastically writes: "I have been out only two evenings and have taken orders for $24.85."

Easy for you to make big money. I look out for welfare of my partners.

I don't want you to take any chances. I GUARANTEE your income. This is the most amazing guarantee ever made for a steady, year 'round income. I can make this **guarantee** because I know you can do as well as my other partners whose letters are shown on this page.

Besides going 50-50 with my partners on profits, I WILL FURNISH YOUR HOME with hundreds of wonderful premiums, including pianos, living room sets, etc., that I give as premiums. Send coupon at once for my signed guarantee of $100.00 a week for full time or $3.00 per hour for spare time work.

I Furnish You Chrysler Coach FREE

This is part of my FREE outfit to you. I want my partners to be prosperous and look prosperous to gain respect from everyone in your locality. That's why I will give you ABSOLUTELY FREE this brand new Chrysler Coach to use in your business. This is no contest! It is yours to keep just as soon as you show me you are in earnest. Send coupon today.

SEND COUPON AT ONCE for APPLICATION

FREE FOOD PRODUCTS COUPON

C. W. VAN DE MARK, VICE PRES.
Health-O Quality Products Co.
DEPT. 2032 AA CINCINNATI, O. HEALTH-O BLDG.

C. W. Van De Mark,
Health-O Quality Products Company,
Department 2032-AA,
Health-O Bldg.,
Cincinnati, Ohio.

Send, at once, application for territory and details of partnership offer, free food products.

Name _____

Address _____

City _____ State _____

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Buy this Convenient Way at Saving Prices!

Your Choice SENT FOR $1 FULL YEAR TO PAY

GUARANTEED SAVINGS

Direct Diamond Importations and volume sales, enable us to offer you genuine diamonds, standard watches and exquisite jewelry at saving prices with the added advantage and convenience of dignified credit.

HOW TO ORDER

Just send **$1** with your order and your selection comes to you on **10 Days Free Trial.** No C. O. D. to pay on arrival. After free trial, pay balance in twelve equal monthly payments.

10 DAYS FREE TRIAL
Satisfaction Guaranteed

If not satisfied after 10 days' trial, return shipment at our expense and entire deposit will be refunded. Written guarantee bond with every purchase.

All Dealings Strictly Confidential

A Full Year To Pay! No extra charges. You take no risk—satisfaction absolutely guaranteed or money back.

CA2 Finest blue white diamond, lady's hand engraved 18K Solid White Gold mounting. $2.25 a month. **$27.50**

CA3 18K Solid White Gold engagement ring, "A. A." 1/4 ct. diamond. $1.00 a month. **$48.50**

CA6 Handsomely engraved 18K Solid White Gold wedding ring, 5 genuine blue white diamonds. $2.50 a month. **$29.50**

CA7 New, lady's friendship ring, 18K Solid White Gold, 7 perfectly matched, blue white diamonds. $2.50 a month. **$36.75**

CA10 Exquisitely hand engraved and pierced 18K Solid White Gold lady's ring. Finest quality, genuine blue white diamond. $3.00 a month. **$37.50**

CA11 Quaint 18K solid green gold ring, 18K white gold top, "A. A." 1/4 ct. blue white diamond. $2.00 a month. **$47.50**

ELGIN "Parisienne" Model

$35

CA12-The **"Madam Jenny"** The latest Paris style engraving for the modern scene. Guaranteed **Elgin** movement. An adjustable model. Supplied in GREEN JADE, BLACK or RUBY ENAMEL. $2.50 a month.

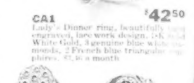
$26.50

CA15-Nationally advertised, **Elgin** or **Waltham**, gentleman's strap watch. Handsomely engraved, 12-size, Green or White Gold filled case. Warranted 20 years. Radium dial, accurate and dependable. Specially priced, $2.12 a month.

CA16-Ultra fashionable, diamond wrist watch, hand engraved 14-K SOLID WHITE GOLD case, 15 ruby and sapphire jewelled movement, 2 blue white diamonds, 4 French blue sapphires. Genuine "WRISTACRAT" bracelet, patented safety clasp. $2.50 a month. **$34.50**

CA17-Gents combination, nationally advertised, **Elgin** or **Waltham** thin model movement, 12 size, hand engraved octagon design, green gold filled case. Guaranteed 20 years. Complete with knife and chain. $1.75 a mo. **$22.50**

CA1 Lady's Dinner ring, beautifully engraved, lace work design, 18K Solid White Gold, 3 genuine blue white diamonds, 2 French blue triangular sapphires. $2.50 a month. **$42.50**



CA4 Dazzling cluster of 7 perfectly matched, finest quality blue white diamonds, 18K Solid White Gold mounting. $2.50 a month. **$48.50**

CA5 The **"Rainbow,"** 18K Solid White Gold engagement ring, hand carved floral design. Finest grade, blue white diamond. $3.00 a month. **$75.00**

CA8 The **"Mayfair"** 18K Solid White Gold, beautifully hand pierced lady's ring. Fine cut grade, genuine blue white diamond. $4.75 a month. **$57.50**

CA9 Artistically hand engraved 18K solid white gold, newest style lady's ring. Perfectly first quality blue white diamond. $2.50 a month. **$75.00**

Convenient Credit at Cash Prices

$25

CA14-The **"Princess Pat"**, 14 K SOLID WHITE GOLD, engraved case. Accurate, dependable 15 jewel movement. Genuine "WRISTACRAT" flexible bracelet. $2.00 a month.

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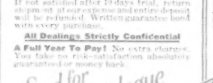
FREE Completely illustrated diamond catalogue of genuine diamond bargains. Explains the Waltham, Elgin, Hamilton, Howard, Illinois watches; fine jewelry, silverware at bargain prices. Write now, to get your FREE copy



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